

5G READY. GET PRIMED FOR **ULTRA SPEEDS**

200C

March 2019
Issue 465

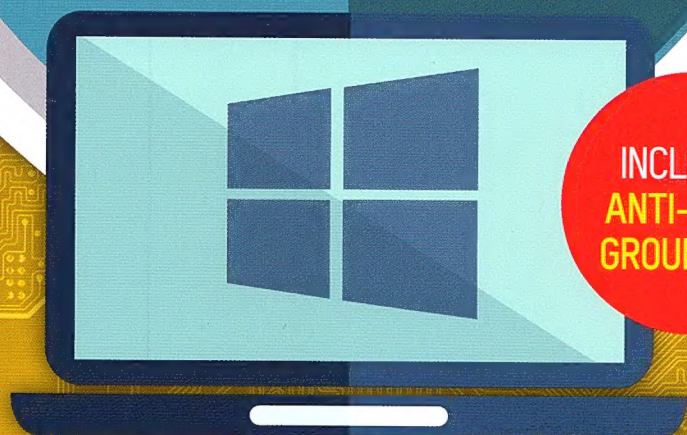
YOUR EXPERT

GUIDE TO TODAY'S TECH

NOW INCORPORATING

PC
& TECH
AUTHORITY

LOCK DOWN YOUR PC NOW!



INCLUDES
ANTI-VIRUS
GROUP TEST

GET THE SECURITY YOU NEED

🔒 BEST FREE FIREWALL
🔒 SECURE YOUR CLOUD
BACKUPS 🔒 LOCK DOWN
YOUR NETWORK
🔒 PROTECT YOUR IDENTITY
ONLINE 🔒 SEND EMAILS
SAFELY 🔒 ULTIMATE
PASSWORD SECURITY

SMARTPHONE
VS. TABLET
VS. CHROMEBOOK

THE BEST WAY TO TAKE THE
INTERNET WITH YOU

THE FUN WE'LL HAVE
2019'S MOST ANTICIPATED GAMES REVEALED!

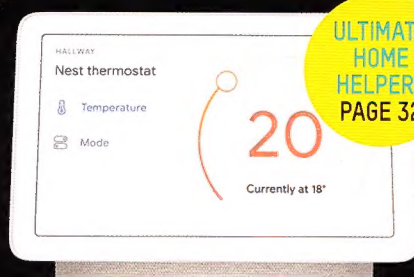
L
TURE
F

AUS\$9.95 INC GST
NZ\$10.90 INC GST
PRINT POST
APPROVED: 100000179
ISSN: 0728-4415



THE YEAR
AHEAD IN
PC TECH
CES 2019 REPORT

BIG REVEALS FROM AMD,
INTEL AND NVIDIA



ULTIMATE
HOME
HELPER?
PAGE 32

LATEST
REVIEWS
GOOGLE HOME HUB

PLUS > NVIDIA GTX 2060
> SAMSUNG 970 EVO PLUS SSD
> MSI P65 PREMIUM LAPTOP
> ASUS ZENSCREEN PORTABLE MONITOR

NBN SMB Solution for Ethernet WAN (FTTP, HFC, Fixed Wireless, Satellite)

DrayTek
Aust & NZ
www.draytek.com.au



Vigor2926Vac

50x
VPN

Vigor2926 Series

Dual-WAN broadband router with Gigabit LAN, Security Firewall, 802.11ac (AC2000) Wi-Fi, VoIP and 50 x VPN tunnels including 25 x SSL-VPN tunnels

- Dual Gigabit Ethernet WAN ports for Failover and Load-Balancing and High Availability mode
- Two USB 2.0 ports for connection to two 3G/4G LTE USB mobiles, FTP server and network printer
- 4 x Gigabit LAN ports with multiple subnets and 50,000 NAT sessions
- 50 x VPN tunnels (including 25 x SSL-VPN tunnels) with comprehensive secure protocols
- Fast VPN throughput, VPN load-balancing and backup for site-to-site applications

- 16 x VLANs for secure and efficient workgroup management
- IPv6 & IPv4
- IEEE 802.11ac (AC2000) wireless Access Point; dual band; up to 1.7Gbps throughput (Vac/ ac model)
- 4G LTE SIM card slot (L model)
- VoIP with 2 x FXS and 1 x FXO Line Port (V model)
- Object-based SPI Firewall and CSM (Content Security Management) for network security
- Supports VigorACS 2 Central Management System for remote management
- Central VPN Management for 8 remote Vigor routers
- Central AP Management for deployment of multiple wireless VigorAPs
- Free Smart Monitor Network Traffic Analyzer for 30-nodes

Vigor2952 Series

Dual-WAN broadband Fibre Router with Security Firewall, 4 x PoE LAN ports (power budget up to 60 Watts), 100 x VPN tunnels including 50 x SSL-VPN tunnels



Vigor2952P

100x
VPN

- 1 x Gigabit Ethernet/SFP combo WAN port, 1 x Gigabit Ethernet WAN port
- Multi-WAN Load Balancing & Failover and High Availability mode
- 4 x Gigabit PoE Ethernet LAN ports with 60,000 NAT sessions (P model)
- Complies with 802.3at Power over Ethernet Plus (P model)
- Supports PoE power up to 30 watts for each port, and total PoE power budget up to 60 watts (P model)
- 1 x USB port (USB3.0) support 3G/4G LTE USB mobile
- 100 x VPN tunnels including 50 x SSL-VPN tunnels with Central VPN Management
- VPN Load Balance and Redundancy
- Object-oriented Firewall with Content Security Management and QoS
- IPv6 & IPv4
- Multi subnet WAN/LAN through 802.1Q
- 1 x USB port (USB2.0) support file sharing, external storage, network printer or thermometer
- Central AP Management; Central Switch Management; Smart Monitor Traffic Analyzer
- Supports VigorACS 2 Central Management System for remote management

Vigor2133 Series

Broadband router with Gigabit LAN, SPI Firewall, 802.11ac (AC1200) Wi-Fi, VoIP and 2 x VPN tunnels (convertible to 2 x SSL-VPN tunnels)



Vigor2133Vac

2x
VPN

- 1 x Gigabit Ethernet WAN port
- 2 x USB ports for 3G/4G access, FTP server and Network printers
- Load Balance and Failover functions for WAN and USB 3G/4G WAN
- 4 x Gigabit Ethernet LAN ports with 30,000 NAT sessions
- IPv6 & IPv4
- NAT throughput over 450Mbps
- Object-based SPI Firewall, Content Security Management (CSM) and QoS
- 2 x VPN tunnels; convertible to 2 x SSL-VPN tunnels
- 802.11ac (AC1200) Wi-Fi, up to 300 + 867Mbps speed
- SIP VoIP (2 x FXS) for Vac model
- Central AP Management for deployment of up to 2 wireless VigorAPs
- Supports VigorACS 2 Central Management System for remote management
- 2 years back to base warranty



i-LAN Technology Pty Ltd trading as DrayTek Aust & NZ
www.i-lan.com.au (02) 9838 8899 sales@i-lan.com.au
www.draytek.com.au © Copyright 2019 i-LAN Technology Pty Ltd. All rights reserved.

apc

Future Publishing Australia, PO Box 1077 Mount Street,
North Sydney, NSW 2059
Tel: (02) 9955 2677 Fax: (02) 9955 2688
Email: apcmag@futurenet.com
Web: www.apcmag.com
Subscription enquiries: Please call CRM: (02) 8227 6486

Editorial

Editor: Ben Mansill
Senior Journalist: Shaun Prescott
Journalist: Joel Burgess
Journalist: Harry Domanski
Journalist: Stephen Lambrechts
Journalist: Sharmishta Sarkar
Creative Director: Troy Coleman
Designer: Sharnee Swinnerton

Contributors

Max Tage Axelsson, JR Bookwalter, Alex Cox, Christian
Crawley, Ian Cutress, Ian Evenden, Matt Hanson, Kenny
Hemphill, Kevin Lee, James Peckham, Nick Peers, Nick
Ross, Mayank Sharma, Ryan Smith, Tom Sykes, Chris
Szewczyk, Alex Wiltshire, Darren Yates, Robert Zak

Photography

All copyrights and trademarks are recognised
and respected

Advertising

Group Advertising Manager: Cameron Ferris
cameron.ferris@futurenet.com

Management

Managing Director: Neville Daniels
Sales Director: Paul Marttila

Printed by Blue Star PRINT (NSW)

Distributed in Australia and NZ by Gordon and Gotch
www.gordongotch.com.au

ISSN 0728-441

We are committed to only using magazine paper which is derived from
responsibly managed, certified forestry and chlorine-free manufacture. The
paper in this magazine was sourced and produced from sustainable managed
forests, conforming to strict environmental and socioeconomic standards. The
manufacturing paper mill holds full FSC (Forest Stewardship Council) or PEFC
certification and accreditation

All contents © 2018 Future Publishing Australia or published under licence. All
rights reserved. No part of this magazine may be used, stored, transmitted or
reproduced in any way without the prior written permission of the publisher.
Future Publishing Limited (company number 2008885) is registered in England
and Wales. Registered office: Quay House, The Ambury, Bath BA1 1UA. All
information contained in this publication is for information only and is, as far as
we are aware, correct at the time of going to press. Future cannot accept any
responsibility for errors or inaccuracies in such information. You are advised to
contact manufacturers and retailers directly with regard to the price of products/
services referred to in this publication. Apps and websites mentioned in this
publication are not under our control. We are not responsible for their contents or
any other changes or updates to them. This magazine is fully independent and not
affiliated in any way with the companies mentioned herein.

If you submit material to us, you warrant that you own the material and/or have
the necessary rights/permissions to supply the material and you automatically
grant Future and its licensees a licence to publish your submission in whole or
in part in any/all issues and/or editions of publications, in any format published
worldwide and on associated websites, social media channels and associated
products. Any material you submit is sent at your own risk and, although every
care is taken, neither Future nor its employees, agents, subcontractors or licensees
shall be liable for loss or damage. We assume all unsolicited material is for
publication unless otherwise stated, and reserve the right to edit, amend, adapt
all submissions.

Privacy statement

If you provide information about yourself this will be used to provide you with
products or services you have requested. We may supply your information to
contractors to enable us to do this. Future Publishing Australia will also use your
information to inform you of other publications, products, services and events.
Future Publishing Australia may also give your information to organisations that
are providing special prizes or offers and are clearly associated with the Reader Offer.
Unless you tell us not to, Future Publishing Australia may give your information
to other organisations that may use it to inform you of other products, services
or events. If you would like to gain access to the information Future Publishing
Australia holds about you, please contact us.



Future plc is a public
company quoted on the
London Stock Exchange
(symbol: FUTR)
www.futureplc.com

Chief executive Zillah Byng-Thorne
Non-executive chairman Peter Allen
Chief financial officer Penny Ladin-Brand

Tel +44 (0)1225 442 244



The people's laptop?

Or an enduring folly?



We have a nice little
head to head this
month. In it, we
wonder in an abstract
semi-science way,
whether a
smartphone is better
than a tablet, or can
a Chromebook
insert itself in to

the equation and topple both?
The conclusion, unsurprisingly,
is that each is fit for a purpose,
and while there's some crossover
we're all better off having simply
the right tool for the job, whatever
yours may be.

Part of the mission for us with that
little comparison was to take a fresh
look at Chromebooks and have
another stab at figuring out where
they belong in the world. And as
always the answer is easy. If you
don't use Office, or apps that are
exclusive to Windows or Mac, or play
PC games, then a Chromebook is the
cheapest (relatively) big screen
device you'll find that does a great
job. Among those three, that is...

Because you can hunt around and
find a pretty decent Windows laptop
that's priced competitively against
many Chromebooks, the battle for
Google is no less uphill than it was
when Chromebooks first launched.
And what a hollow launch that was.
Back in 2011 when the first
Chromebook hit, Google's apps were
still outsiders, with almost all
corporates and home users running
Office. That app suite is the killer
pitch for Chromebook, and times

have changed. While its market
share is still utterly dwarfed by
Office, many people have tried one of
the apps, usually Docs, and the news
just keeps coming of big companies
making the switch, and that all
means the initial mistrust
is evaporating.

We use Google Apps here at the
mag, and I've come to appreciate the
benefits, and could definitely see
myself running around town to
meetings and launch events with a
Chromebook tucked into my bag. I
prefer Office, but can get by without
fuss with Google.

I love that Google and its partners
keep plugging away at the
Chromebook. If it ever does become a
truly mainstream work tool it'll be
2030 or later, I reckon. In the
meantime Chromebooks need to stay
true to the fundamentals. They need
to stay cheap, more than anything.
It's too soon to push premium
Chromebooks out into the market,
because, let's not forget, you can do
everything a Chromebook can on a
Windows laptop or Mac. That's a
fight that's never going away and for
Google the right play is to keep
improving its Apps, and score a few
more goals in the enterprise space
because selling them as student
budget machines isn't enough of a
chunk in the market to guarantee
Chromebook's future. ■

BEN MANSILL

EDITOR

ben.mansill@futurenet.com

Contents

Issue 465 March 2019

LOCK DOWN

YOUR PC NOW!



40

GET THE SECURITY YOU NEED

🔒 BEST FREE FIREWALL

🔒 SECURE YOUR CLOUD

BACKUPS 🔒 LOCK DOWN

YOUR NETWORK

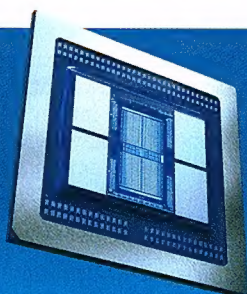
🔒 PROTECT YOUR IDENTITY

ONLINE 🔒 SEND EMAILS

SAFELY 🔒 ULTIMATE

PASSWORD SECURITY

56



//CES 2019

//THE YEAR AHEAD
IN PC TECH

» features

40 LOCK DOWN YOUR PC NOW

Worried about your online and offline security and privacy? Nick Peers reveals the tips and techniques you need to lock down your computer.

56 CES 2019

The year ahead in PC tech. Bombshells galore from AMD, Nvidia, and Intel, plus monitor innovation continues to explode.

64 QUANTUM COMPUTING

Mats Tage Axelsson introduces you to quantum computing, the coolest tech around; learn how it works, and how you can get started.

68 GAMES FOR 2019

From heavy gunfire to forest spirits, here are our top tips for 2019.

» technotes

10 NEWS

The latest developments in the tech world.

14 NUMBER CRUNCH

The numbers behind the big tech news.

15 TECH BRIEF

The evolution of existing technology.

16 GADGETS

Hot tech gear we want to own.

18 HOW IT'S DONE

All the small things inside the Mac mini.

00 END USER

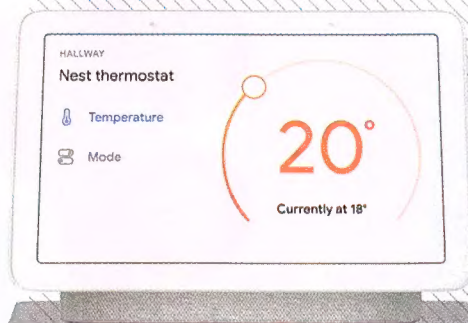
Shaun Prescott writes on the things that matter in tech.

"Literally all of the feature-packed free anti-malware versions are annoying at best and dishonest at worst."
Page 52



CORRECTION

An incorrect product photo was shown with the Asus Vivobook S15 S530F review on page 25 of APC 464. The image shown was an Asus Zenbook, the correct Vivobook is shown here. We apologise for any inconvenience.



32 GOOGLE HOME HUB

24 ALIENWARE M15 GAMING LAPTOP

» the lab

20 HEAD TO HEAD

Smartphones vs. Tablets vs. Chromebooks

22 LATEST REVIEWS

- 22 MSI P65 laptop
- 23 Asus Zephyrus S GX531GM laptop
- 24 Alienware m15 gaming laptop
- 25 Samsung 970 Plus SSD
- 26 Samsung 860 QVO SSD
- 27 Asus Zenscreen Go MB16AP portable monitor
- 28 Nvidia GTX 2060
- 30 MSI Meg z390 Godlike
- 31 Asrock X399 Phantom Gaming 6 Motherboard
- 32 Google Home Hub
- 34 Huawei Watch GT

35 SOFTWARE REVIEWS

- 35 Windows
- 36 Apple macOS
- 37 Apple iOS
- 38 Android
- 39 Linux

74 PC BUILDER

- 74 System News
- 75 Market Watch
- 76 Blueprint
- 77 PC Builder Masterclass

» how to

84 QUICK TIPS

- 84 We fix your tech problems



29 MSI RTX 2060



31 ASROCK X399 PHANTOM GAMING 6 MOTHERBOARD

86 TUTORIALS

- 86 Personalise Windows 10
- 90 Manage your smarthome
- 92 Hidden powers of the Option key
- 94 Extend your editor to email and video

98 MASTERCLASSES

- 98 Optimise your Pi for better performance
- 100 2019 Mobile CPU Roadmap
- 102 Python for Machine-Learning Part 1: Introduction

» downtime

106 GAMING NEWS

The latest in gaming news

108 GAMES REVIEWS

High-performance gameplay

110 GAME CHANGER

Diablo III



exclusive software

» HOW TO DOWNLOAD YOUR FREE FULL-VERSION PROGRAMS

ISSUE 465, MARCH 2019

Please note that these exclusive APC magazine downloads will only be available for a limited time, from **25/02/2019 to 21/04/2019**

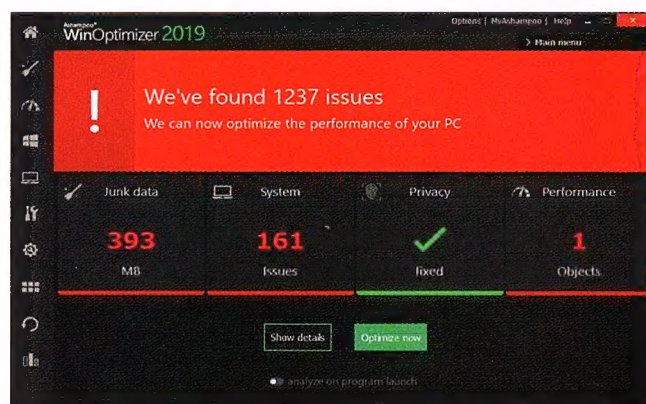


Optimise for performance and stability
KEEP YOUR PC HEALTHY WITH SHAMPOO WINOPTIMIZER 2019.

FULL VERSION WORTH \$50

Ashampoo WinOptimizer 2019 boosts, cleans and optimises the performance of your Windows system far beyond what built-in tools can deliver. Multiple included modules help analyse, customise and tweak Windows to your needs. One-click optimisation removes clutter, fixes invalid shortcuts and cleans your browsers off redundant data like browsing history entries and cookies. PC maintenance tools remove junk files and browsing traces and also clean the Registry database. Powerful process and service management tools along with boot optimisation help improve Windows startup times. Ashampoo WinOptimizer 2019 also features powerful system analysis for detailed information on installed software and hardware.

DOWNLOAD LINK: www.ashampoo.com/lpa/apcmagazine



Capture screen recordings in 4K
CAPTURE ANYTHING ON YOUR MONITOR WITH ABELSSTOFT SCREENVIDEO.

FULL VERSION WORTH \$50.

With ScreenVideo, you can create videos of everything on your screen with just one click. You decide whether you want to record the whole screen or just a part of it. To explain something to someone, a video is ideal. The practical moderator function uses picture-in-picture technology to integrate you directly into the corner of your screen video. All you need is a webcam and off you go!

DOWNLOAD LINK: www.apcmag.com/exclusives

DOWNLOAD ZIP password: March19a (note this is case-sensitive)



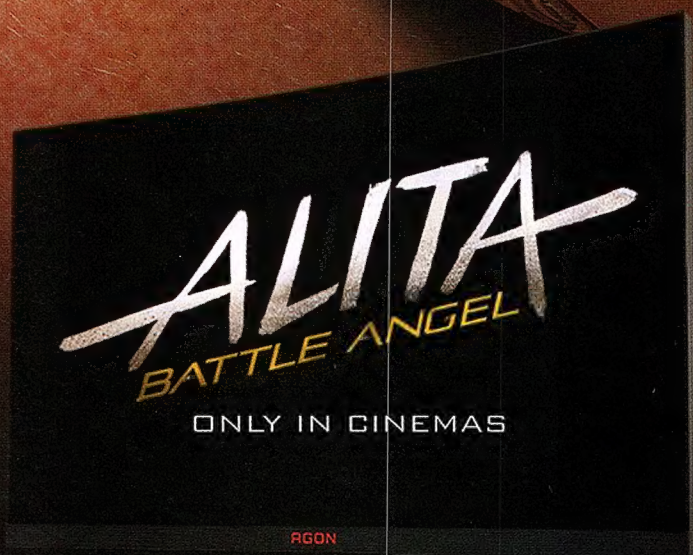
DISCLAIMER Future Publishing is not the licensor of the exclusive software or any documentation included with it. Rather, Future is merely a distributor of the software, and your use of the software is subject to any accompanying third-party licence terms. You must carefully read and comply with any such third-party licence terms, together with all instructions and README files that come with the software. Accordingly, to the maximum extent permitted by law, all software is provided by Future 'as is' and without warranty, either express or implied, and Future will not be liable for any damage that you may incur as a result of using any software downloads. You should back up any important system and data files before using any downloaded software. We recommend that you do not use the exclusive software on a production machine. Nothing in this disclaimer excludes any warranty that may be implied by statute, which may include the Trade Practices Act. While we have taken all reasonable steps to check the software downloads for viruses, we cannot guarantee that it is free from viruses or other harmful code and you should check each download using a virus scanner complete with the latest antivirus updates before use.

AOC

BATTLE, COMPETE, GROW
UNLEASH YOUR POTENTIAL



AOC GAMING



reddot design award

165 Hz

1 ms

NVIDIA G-SYNC



© 2019 Twentieth Century Fox Film Corporation. All rights reserved.



www.aoc.com

vision at Heart

the lab
LATEST REVIEWS



MSI P65 8RE

MSI's prestige ultrabook is basically a GS65 in a silver suit, but is this professional powerhouse perfect?

[illegible]

The overall performance was 98% of what we expected for M3's G565 Stealth. Thin in new CPU benchmarks, which is unsurprising considering the shared cache. In the 3D tests, we tested the silver P65 6R2E with a GTX 1060 (M3's GPU) and the white G565 has a GTX 1070 (M3's GPU). The P65 had a 20% drop in gaming frame rates across our benchmarks was around what we expected. The P65's read speeds were a bit faster. Its write speeds of 934 MB/s were less than half what the G565 scored. The P65's battery life is good, uses a newer NVMe drive, allowing it to double the write speeds.

Battery life was also what we expected with the P65 lasting 3 hours and 53 minutes in the PCMark Home battery benchmark. The G565 lasted 4 hours and 40 minutes. This slight

The nicer looking design, 144Hz refresh rate, 512GB SSD and better GPU of the White Limited Edition P65 8RF means we would give it at least a mark above the P65 8RE's score here, if you can get it for a similar price. **■ Joel**

Burgess

Verdict

If you glimpse the Limited Edition WY P45 S&T chain bag II, but the P45 S&T has a couple of critical shortcomings that make it not such a sure thing.

★★★★★

Verdict

If you glimpse the Limited Edition WY P65 SR7 then bag it, but the P65 SR7 has a couple of critical shortcomings that make it not such a sure thing.

★★★★☆



Evo Plus

When you're looking for a new car, you want to know what you're getting. And you want to know what you're getting for your money. That's why we've put together a list of the best cars in the world. We've looked at everything from the smallest to the largest, from the cheapest to the most expensive. We've found the best of the best. And we've put them all in one place. So you can see what you're getting for your money. And you can see what you're getting for your money.



Persons with a history of alcohol abuse are at an increased risk of developing a variety of psychiatric disorders. The prevalence of psychiatric disorders in this population is high, and the risk of relapse to alcohol abuse is also high. The purpose of this review is to discuss the prevalence of psychiatric disorders in persons with a history of alcohol abuse, and to discuss the risk of relapse to alcohol abuse in this population.

the 1990s, the U.S. economy has been growing at a slower rate than in the 1980s. The U.S. economy has been growing at a slower rate than in the 1980s. The U.S. economy has been growing at a slower rate than in the 1980s.



NVIDIA GeForce RTX 2060 Founders Edition

For the first time in its history, the National Transportation Safety Board (NTSB) has issued a report that says the Federal Aviation Administration (FAA) is not doing enough to prevent airline accidents. The report, titled "The FAA's Role in Reducing Commercial Airplane Accidents," was released on March 1, 1990. It is the first of a series of reports that the NTSB will issue over the next several years. The report says that the FAA is not doing enough to prevent airline accidents because it is not doing enough to enforce the rules that govern airline safety. The report also says that the FAA is not doing enough to improve the design of commercial airplanes. The NTSB says that the FAA should do more to enforce the rules that govern airline safety and that it should do more to improve the design of commercial airplanes. The NTSB also says that the FAA should do more to improve the way it manages the airline industry. The report says that the FAA should do more to enforce the rules that govern airline safety and that it should do more to improve the design of commercial airplanes. The NTSB also says that the FAA should do more to improve the way it manages the airline industry.

Find out all about APC's editorial policies, test practices, how to read the benchmark results, and more.

We're also an open church in terms of platforms. We know most people aren't wed to a single brand's products and use a variety of devices. And, like you, APC's journalists want to know what's good in tech – no matter what platform it resides on.

INDEPENDENT REVIEWS

Championing technology doesn't mean we're unrelenting yes-men and -women, however, and APC aims to be as objective as possible in all our coverage. That means identifying the best products from multiple perspectives – the best performance, best value and best features and, ideally, the products that offer the best mix of these three.

As a matter of policy, reviews published in *APC* are not shared with product-makers prior to print. We will contact vendors under certain conditions; for example, if we have a problem testing a product that seems to indicate it may be faulty, or to invite a vendor to clarify how a particular feature works. If an *APC* reviewer has any potential conflicts of interest involving a brand, the review will always be assigned to another writer.

LABS TESTING

Despite being a small magazine with limited resources, APC still strives to conduct the most rigorous, objective scientific tests and benchmarks we can so as to make our reviews as unbiased as possible. We use a variety of tools and programs for this, including many freely available benchmark suites for assessing media encoding, general system performance, gaming and battery life.

In most cases, for the benchmark results published in APC, you can assume that higher is better. There are certain tests that deviate from this rule where the opposite is true; in those cases, we've flagged the results with a note explaining as such.

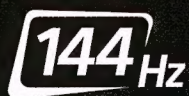
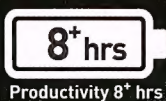
We use both tables and graphs for displaying results; the latter are our preference due to their ease-of-readability, but tables are more compact, so we use these in cases where thoroughness is preferred.



Starting from \$3099

THE GAME JUST GOT REAL

GS75 *Stealth*



Up to Intel® Core™ i7 processor | Windows 10 Home | Up to NVIDIA® GeForce RTX™ 2080

TRUE GAMING

*Product features and specifications may vary by model.

Intel, the Intel Logo, Intel Inside, Intel Core, and Core Inside are trademarks of Intel Corporation in the U.S. and/or other countries.

[MSI.COM](https://www.msi.com)

technotes

» HARRY DOMANSKI WITH THE NEED TO KNOW NEWS

A crackdown in China has led to some Twitter users being detained

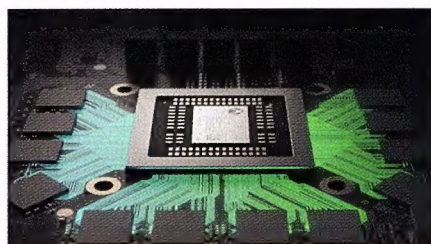
EIGHT HOUR INTERROGATION FOR ONE UNLUCKY USER.

A report by *The New York Times* has revealed that Chinese Twitter users posting negative comments about the country's government have found themselves being detained and questioned by police. One such instance saw someone held in a detention centre for 15 days while another citizen was chained to a chair for eight hours while interrogated. Twitter is banned in China as part of the government's internet censorship campaign.

Popular Chrome ad-blockers could be crippled under proposed design changes

BLOCKING THE BLOCKERS.

Google is planning on making changes to its Chrome Extensions platform and is currently drafting changes in a public manifest. According to the manifest, Google will "strive to limit the blocking version of webRequest". It goes on to suggest that "content blockers should instead use declarativeNetRequest", a move that will cripple a wide variety of ad blockers, including uBlock Origin and uMatrix.



Xbox Scarlett might be the first console with discrete graphics like a gaming PC

SERIOUS GRAPHICS POWER.

Purported Xbox Scarlett specs have appeared on Reddit suggesting that Microsoft's next console will utilise an Arcturus 12 GPU featuring 64 'Arcturus Engines' and a total of 4,096 GPU cores (compared to the Xbox One X's 2,560 GPU cores). If this is the case, it is very likely that it will be made into a discrete GPU given its theoretical size.



One in five email attacks uses compromised accounts

Account takeover attacks allow cybercriminals to bypass email filters.

Account takeover-based (ATO) attacks now comprise 20 percent of all advanced email attacks according to new research from the email security and protection company Agari.

This rise in popularity is largely due to them being more difficult to detect than traditional attacks and their ability to bypass email filters since they are sent from a real sender's email account. Senior Director of Threat Research at Agari, Crane Hassold provided further insight on the threat posed by ATO attacks, saying: "Credential phishing was already a huge risk for organisations because of the potential for data breach, but now there is a new wave of account takeover attacks leveraging compromised accounts to commit additional fraud." According to Agari's Cyber Intelligence Division, brand impersonation remains the most common attack vector and this technique was used in 50 percent of advanced email attacks during Q4 2018 with cybercriminals impersonating Microsoft in 70 percent of these instances. Microsoft is often a target for credential phishing since attackers can use Office 365 accounts in subsequent ATO attacks.

Microsoft is preparing Windows 10 for foldable devices

GETTING READY FOR ANDROMEDA?

We've seen plenty of rumors of Microsoft making a foldable Surface product, but this is the first time we're hearing that the company is reprogramming Windows 10 to support them. A new build of Windows 10 (numbered 18313.1004) coded with references to foldable devices has appeared, according to Windows-centric blog Buildfeed. Within the build, users can find this specific string: 'rs_shell_devices_foldables.190111-1800.' It seems likely that this new Windows 10 build has been designed to support Microsoft's long-rumoured Andromeda devices, which we've heard will include dual-screens and foldable devices. Even without Microsoft's help, we've already seen a range of dual-screen Windows 10 devices including two generations of Lenovo's Yoga Book, the Asus Project Precog and Intel's prototype Tiger Rapids. Although Microsoft seems to be nowhere near ready to produce a dual-screen Surface, the market is already ripe for foldable hardware, and it's about time for Windows 10 to start supporting them.

2TB

COPILOT

No Computer required
to Backup

- Built-in SD card slot and USB port for direct transfer of files
- Power bank feature to charge phone on the go
- 3-year Limited Warranty and Rescue Data Recovery Services

1
STEP



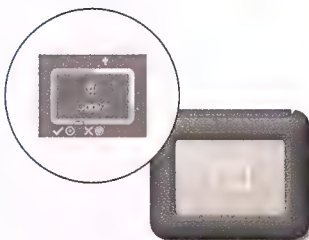
Copy files via SD card slot.

2
STEP



Or, plug directly into your
USB devices.

3
STEP



Status screen alerts you once
file transfer is complete.

4
STEP



View and organize files in full
resolution from your mobile device.

BACKUP ANYWHERE ANYTIME



DJI CERTIFIED BACKUP DRIVE



AVAILABLE AT:

JB HIFI



APPLE STORE



WERETOBUY.LACIE.COM

DISTRIBUTED BY DICKER DATA LTD

DICKER
DATA

GENERAL ENQUIRIES: 1800 688 586



Windows 10 April 2019 Update will offer solutions along with error messages

OFFERING MORE HELP.

It looks like error messages will be more helpful in the upcoming Windows 10 April 2019 Update, at least when installing Windows 10 and its major updates, as they will now also offer up suggestions on how to fix the issue. When a problem is encountered, users should see options to try to fix it, as well as a 'Learn more' link that will take people to the relevant Knowledge Base article.

2018 offers us our first full-year decline in smartphone sales

IF YOU DIDN'T BUY A PHONE LAST YEAR, YOU'RE NOT ALONE.

Multiple market research reports assert that global smartphone shipments had a full-year decline for the first time ever in 2018. With the average cost of smartphones rising considerably and an arguable lack of true development in the field, more consumers were holding onto their old handsets rather than succumbing to the yearly refresh.



Apple's touchscreen MacBook keyboard may be unlike anything we've seen

A FULLY GLASS TOUCHSCREEN PANEL WITH RAISED, TACTILE KEYS.

It's been rumoured that Apple is working on a touchscreen keyboard for an upcoming MacBook product, but a recently-filed patent suggests the new keyboard could be more revolutionary than first thought. It seems that Apple doesn't just want a touchscreen keyboard, but is designing one with raised, tactile glass keys that offer haptic feedback when touched.



TPG kills its 4G network rollout following Huawei ban

Calling it quits on Australia's fourth mobile network.

TPG was keen on becoming Australia's fourth largest mobile carrier, sinking \$1.9 billion on setting up its own 4G network. The service was switched on in 2018, and was supposed to cover 80% of the country's population. But with only a few metro areas in Sydney currently covered, the rest of the build has been abandoned, with TPG citing the August 2018 ban on Huawei as the main reason. Huawei has been TPG's sole provider of small cell boxes needed for mobile services. The Federal Government's ban on the Chinese manufacturer's equipment, however, has thrown a spanner in the works, with TPG claiming it "does not make commercial sense" to carry on pouring money into building the network. "A key reason for the selection of the vendor and the design of TPG's network was that there was a simple upgrade path to 5G, using Huawei equipment," the telco announced in a statement.

New 'collection' data dump contains 2.2bn usernames and passwords

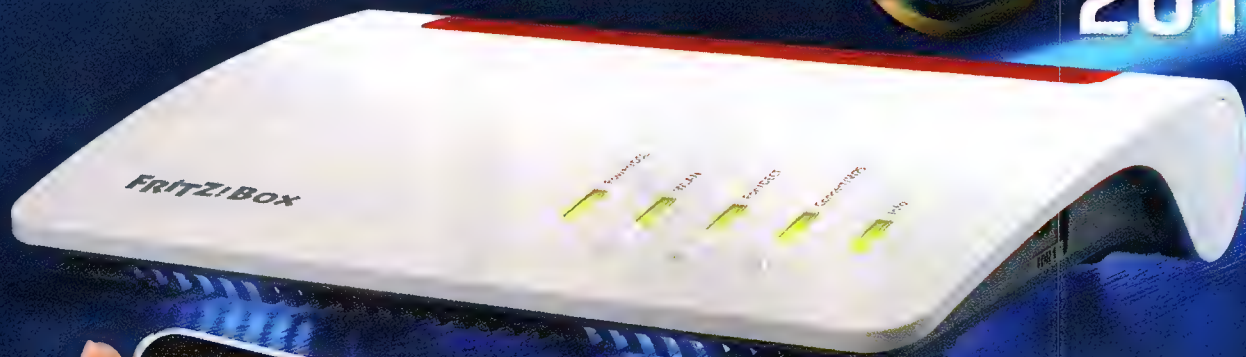
COLLECTION #2-5 IS ALMOST THREE TIMES LARGER THAN COLLECTION #1.

Earlier this month, Have I Been Pwned's Troy Hunt brought attention to the largest ever online data dump, containing 12,000 separate files and over 87GB of data holding 773m unique email addresses and 22m unique passwords. Hunt referred to the wealth of personal data he found on MEGA as Collection #1 and now Collection #2-5 has appeared online containing 2.2bn unique usernames and passwords along with 845GB of data and over 25bn records. Much of the stolen information contained in Collection #2-5 is from previous data breaches that affected Yahoo, LinkedIn and Dropbox, but these details could be utilised by hackers to launch credential stuffing attacks and attack users' other accounts that use the same details. At the time of writing, Have I Been Pwned had not yet added these newer collections to its database, but if you want to check if your account has been compromised, check out Hasso Plattner's Info Leak Checker.

Quality entertainment around the clock
 Enjoy great entertainment throughout the entire home network.
 Keep everything as simple as possible.



**GERMAN
 DESIGN
 AWARD
 WINNER
 2018**



Made in Germany



**Encrypted communication
 via VPN**



**At home anywhere with
 MyFRITZ!**



**Answering machine with
 voice to mail**



**Ready for the future with
 IPv6**



**FRITZ!Apps for iOS
 and Android**



**Smart WiFi technology
 Multi-User MIMO**



**Two wireless networks
 for more flexibility**



**Band steering:
 smart band selection
 convenience**



**Mesh WiFi with FRITZ!
 enjoy full mesh networking**



**Connected in no time
 with WPS (Wi-Fi Protect-
 ed Setup)**

numbercrunch

» WE LOOK AT THE NUMBERS DRIVING THE BIG TECH NEWS.



\$8.2

MILLION

AMOUNT OF MONEY FACEBOOK HAS PLEDGED TO HELP TRAIN JOURNALISTS IN THE UK.

– and so help combat the spread of “fake news”. The Community News Project money will be distributed by the National Council for the Training of Journalists.

70%

CHANCE THAT SPACEX FOUNDER AND TESLA BOSS, ELON MUSK, WILL MOVE TO MARS.

He's made the claim several times before, but never attached a figure of probability to it. He'd better hurry up – SpaceX's first Mars mission is currently scheduled for 2022.



200 MILLION

NUMBER OF PEOPLE WHO HAVE NOW REGISTERED TO PLAY ONLINE GAMING PHENOMENON FORTNITE

A jump from 125 million in June 2018. Creator Epic says the game now has 8.3 million concurrent players – a new record.

US\$812.93 BILLION

MARKET CAP REACHED BY MICROSOFT ON 27 NOVEMBER, MAKING IT – BRIEFLY – THE WORLD'S MOST VALUABLE COMPANY AFTER A HIATUS OF EIGHT YEARS.

The company snatched the slot from Apple, whose own market cap had slipped from a peak of US\$1 trillion in August 2018 to US\$812.60 billion on that same day in November, largely as a result of investor concerns over iPhone sales.

100,000

NUMBER OF HOLOLENS HEADSETS THAT THE US ARMY IS EXPECTED TO BUY FROM MICROSOFT IN A US\$480 MILLION DEAL.

The headsets will be used for training and live combat purposes. “Augmented reality technology will provide troops with more and better information to make decisions,” Microsoft says.

\$5,094

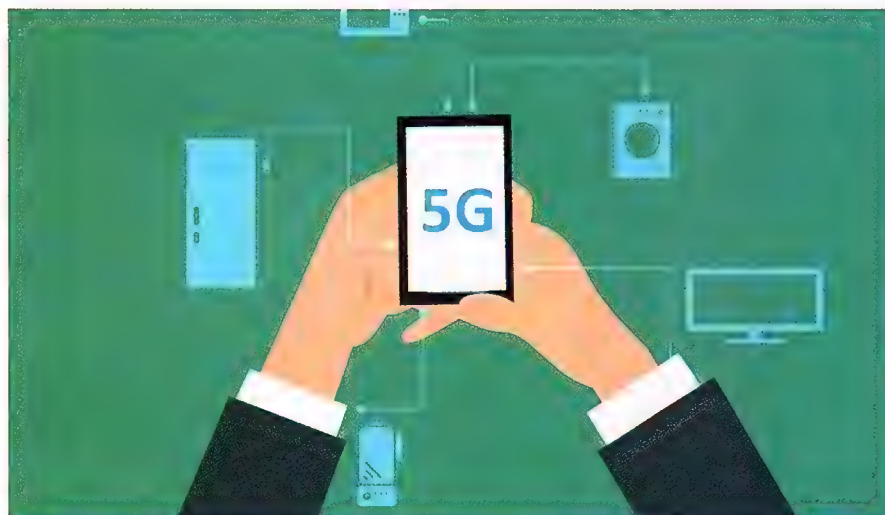
REAL-MONEY VALUE OF A SINGLE BITCOIN IN JANUARY 2019

A fall of 81.5 percent from the \$27,431 peak it reached in December 2017. The cryptocurrency's dramatic fall has been attributed to nervousness among Bitcoin traders, plus the arrival of several forks of Bitcoin, including Bitcoin Cash. ■

The 5G state of play

What to expect, and what not to, in 2019.

5G comes with the promise of faster internet speeds and more reliable connections on smartphones and other devices. It uses cutting-edge network technology to offer download speeds of up to 20Gbps, and users should see an average speed of 1Gbps at the very least. These kinds of speeds are typically seen on fixed-line networks, meaning 5G could well be nicknamed 'fibre to the smartphone'. 5G will also help power the next generation of Internet of Things (IoT) devices, providing the infrastructure to transfer huge amounts of data within split seconds, allowing manufacturers to produce smarter gadgets to connect the world. Development and testing is already underway, and is backwards-compatible with the existing 4G network to provide speedier connections to let you stay online no matter where you are.



Australian telcos get ready for the 5G rollout

The transition to the next generation of mobile network has begun.

In December 2018 Telstra became the first Aussie telco to enable 5G across several sites in Melbourne and Sydney. Optus, trying to compete with Telstra, promised to begin its 5G rollout in January for Canberra and Brisbane, but the ISP has backpedalled with no specific reasons given. Vodafone, however, is biding its time and won't switch on its own 5G network until 2020. At the time of writing, though, Optus plans to at least switch on its 5G base stations in both cities, with no indication as to when consumers will have access to this tech.

5G smartphones arriving in 2019

Android options incoming, but Apple decides to wait.

At the time of writing, not a single 5G-enabled handset was available in Australia, but many of the big players had already announced smartphones capable of supporting superfast speeds. The Samsung Galaxy S10, Huawei P30, and OnePlus 7 are scheduled for launch this year. If what Qualcomm's president, Christiano Amon, said at CES was true, then "every Android vendor is working of 5G right now". And he should know, the chip maker, after all, has developed next-gen CPUs to power the upcoming handsets (see more on page 100). Apple, however, will wait till 2020 to launch a 5G-enabled iPhone as, the company states, technical issues will ideally have been ironed out by then.



Why are countries banning Chinese manufacturers?

The story behind the Huawei ban.

Huawei has been making headlines around the world for supplying tech to the Chinese government that it allegedly uses to spy on other nations. The company has denied the allegations, but it hasn't stopped countries like the US and Australia from banning the use of the Chinese manufacturer's 5G equipment. Every Chinese company is required to aid with intelligence gathering as and when required, according to a recent and alarming Chinese government decree. This has led to widespread security concerns over using products manufactured by Huawei and ZTE. After the US, the UK, Australia and New Zealand issued a ban on Huawei, Canada arrested the company's CFO for violating international sanction against Iran. Despite China threatening "severe consequences", more countries followed suit. By the end of 2018, Japan, France and Germany said they would not purchase 5G equipment from Huawei.

The next generation of mobile connectivity comes with fast network speeds, meaning more data can be sent across the ether, with millions of devices potentially being connected into what some call a web of surveillance. With every country keen on keeping its 5G network secure, Huawei's chances of becoming "the world's biggest supplier of telecoms gear" may be restricted due to its links to the Chinese government.

5G vs NBN: replacement or complement?

The battle between gigabit and 100Mbps speeds is ready to rumble.

The NBN rollout is due for completion in 2021, while 5G is still in its nascent stages. According to Vodafone's CEO, Inaki Berroeta, the complete and stable rollout of 5G is still years away, by which time NBN will be have become well established. Interestingly, NBN chief Bill Morrow felt threatened enough by the new spectrum to suggest a tax on mobile broadband services, as 5G could potentially complement the national broadband network, provided coverage is far-reaching. ■

gadgets

» GOOD GEAR

TICWATCH C2

This 2nd gen' TicWatch ticks a lot of boxes.

\$300 | WWW.MOBVOI.COM

The original Ticwatch range got a lot of attention for offering the features of a premium smartwatch at a much lower price. The TicWatch C2 has the same elevator pitch, but it's just much, much better. A lot of this is due to Google's updated, and much better, Wear OS, but the C2 is also significantly more responsive, a little slimmer and has a sleek new minimalist design. While it doesn't quite have the 5ATM waterproofing of the TicWatch E2 and S2 that were announced at CES, it is IP68 water resistant. With access to Wear OS's broad range of apps and smartwatch faces, the C2 is almost on par with Apple or Samsung's premium smartwatch offerings.



ECOVACS DEEBOT OZMO 960'S

Robo-vacuum uses AI to avoid your socks.

\$TBC | WWW.ECOVACS.COM/AU/



If you have a robot vacuum at home, there's a good chance you've had to retrieve a partially digested charge cable from its teeth or rescue it from a failed 4WD attempt over a shoe. Ecovacs are taking this problem head on with new AI software that'll recognise ground dwelling possessions like socks and unruly rugs, and will attempt to avoid them. The Deebot Ozmo 960 won't be available till the second quarter of 2019 in the US, at the earliest, and local release and pricing are still to be confirmed. All footage is analysed by onboard processors and won't be sent to the cloud, so there's no opportunity for snooping.

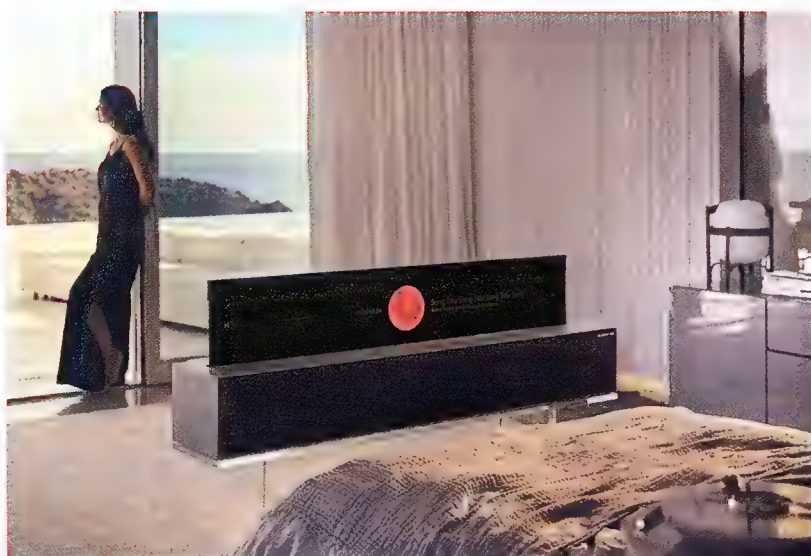
LIAN LI DK-04 F DESK PC

Standing PC desk with adjustable glass frosting.

\$2,499 | WWW.LIAN-LI.COM

Lian Li's adjustable height desks have been housing premium PC components for some time now, but a new model, shown off at CES, can flick between transparent and frosted glass to hide your flashy RGB components when you need to focus. The DK-04 already offered motorised height adjustment for multiple working positions, ATX motherboard compatibility and convenient front-mounted interface connections to make a compelling argument for this clever hybrid desk/PC-case. The new models are expected to be made available sometime this year and while pricing is still unknown, the current models go for \$2,499.





LG SIGNATURE OLED R

LG hope new TV is rolled-gold.

FROM US\$15,000 | WWW.LG.COM

One of the clear highlights of CES 2019 was LG's latest Signature OLED R9, a 65-inch flagship TV that'll roll itself into a compact box when you're not using it. Apart from rolling out this HDR coloured carpet every time you want to watch something, the base box actually features a 4.2 channel Dolby Atmos sound system that you can stream music from when you don't want to watch anything. With AI audio upscaling and an E-Series quality OLED screen there's a lot to pine for here, but with a price tag estimated to be anywhere from US\$15,000 to US\$50,000 not many will be able to actually afford one.

LG HOMEBREW

The Nespresso of beer brewing.

\$TBC | WWW.LG.COM

Beer brewing has been a pastime for as long as we've had pastimes, but it's definitely going through a resurgence in many parts of the globe and LG is hoping to capitalize on the modern hop and grass-roots movement with a new all in one brewer. LG HomeBrew is attempting to revolutionise the home brewing process, the way Nespresso did with coffee, by creating a self brewing, fermenting and cleaning container that works using just water and capsules. The HomeBrew will release with five types of beer capsule that contains malt, yeast and hop oil to easily create a range of beer styles.



LYNQ LONG-RANGE LOCATION TRACKER

The missing LynQ in location trackers.

US\$209 | WWW.LYNQME.COM

Lynq is a new kind of location tracker that uses a combination of GPS and low power radio communication to keep up to 12 people connected in any environment. This carabiner-shaped tracker uses a circular e-ink screen to display the direction and distance of up to 12 other devices at distances of up to 5 km. While this clearly makes sense for hiking or snowsports groups, Lynq doesn't require 4G connections so it'll work equally well in congested spaces like music festivals. Lynq is taking pre-orders at a 30% discount of the expected RRP and the first shipments are expected to kick off in June 2019. ■

how it's done



Mac Mini 2018

All the small things.

Apple's once-neglected Mac mini is coming in hot with a brand-new, cutting-edge, long-awaited... processor upgrade? And a couple more ports? There must be more, and we know how to find it – with a teardown!

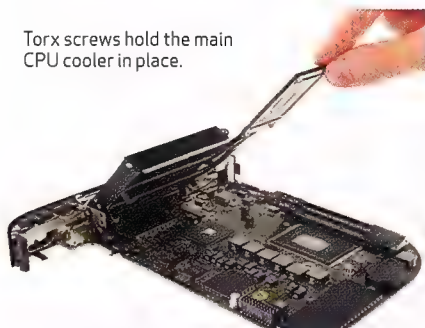
MAJOR TECH SPECS

- 3.6GHz quad-core Intel Core i3 with 6MB shared L3 cache
- 8GB of 2,666MT/s DDR4 SO-DIMM memory
- 128GB SSD
- Intel UHD Graphics 630
- 802.11ac Wi-Fi and Bluetooth 5.0
- macOS Mojave

KEY FINDINGS

- Our first look at the 2018 mini's exterior gives us the warm and fuzzies – it's the same friendly form factor we remember. Despite controversial departures from a

Torx screws hold the main CPU cooler in place.



few common ports, Apple has included plenty of them here. We spot two USB-A ports, four USB-C ports, a headphone jack, an Ethernet port, and an HDMI port (which isn't available on any other recent Apple product).

- With some trepidation, we point our tools at the 60-percent-recycled-plastic bottom cover. Success! An opening tool takes care of the base, and six quick stabs with the TR6 Torx security driver loosens the familiar antenna plate underneath. So far so good.
- We're greeted by a single fan standing watch over the insides. The fan unscrews with zero fuss, giving a better view of the mini's depths. A firm push on either side of the blower exhaust, and the board unclips and slides out.
- With the board out, we're going straight for the RAM. Apple has trapped it in a heavy metal cage – almost as if it doesn't fully trust modular RAM to behave itself. Actually, we've seen this in iMacs of yore. The shield allows the RAM to operate at high frequency (2,666MT/s) with no chance of interfering with other functions. Twirl away four Torx screws, and the cage slides off. Has RAM replacement ever been easier? Sure it has – but the return to standard SO-DIMM RAM after the bitter disappointment of the 2014 mini's



Removing this fan is the first step in accessing the Mini's internals.

soldered-down chips is a huge win.

- Just one connector and two screws set the little system speaker free. iMac and MacBook speakers seem to get bigger all the time, but this looks about the same size as in older Mac minis. Beneath the speaker, we find some antenna cables, but no modular AirPort card – in what is becoming a trend, these are socketed to the main board.
- From here, we set to work freeing the heatsink, twirling away Torx screws, and exposing the paste-y (soldered) CPU. One last screw, and the port cover is free, uncovering the ports. As it departs, it takes some antenna hardware with it. The last thing between us and an empty mini is the internal power supply, which is a nice enclosed unit, making for safe, easy replacement.
- Repairability score: 6 out of 10 (10 is easiest to repair). No tough adhesive holds the Mac mini hostage, and disassembly is straightforward. The mini packs standard SO-DIMMs, allowing both DIY upgrades and replacements. The CPU and storage are soldered to the logic board, and not user-upgradeable. If any of the many ports is damaged or worn, the entire logic board will need replacing. ■



Report blasts Liberal's FTTN ahead of likely early election

The NBN comedy of disasters won't come to an end anytime soon, writes Shaun Prescott.

Here's a compelling theory: according to former prime minister Kevin Rudd, the national embarrassment that is the NBN can at least partially be blamed on Foxtel. That is, Rudd claims to have evidence that News Corp mogul Rupert Murdoch worked to undermine the then-incumbent Labor Party's plans for the infrastructure, which would bolster the burgeoning reach of Netflix and, it was thought, diminish the competitiveness of Foxtel.

During a reddit AMA ('Ask Me Anything') in January to promote his book, Rudd didn't pull punches. He alludes to compulsory News Corp stock exchange filings in 2013, which heavily reference the threat that more robust internet infrastructure could have on its services. "It was no coincidence that when the Liberals came up with an NBN that was only Fibre optic to the node (therefore killing the last link between the node and the household) that News Corp embraced it with open arms," Rudd wrote, going on to call for a royal commission into the affair.

The Australian Competition and

Consumer Commission last month released the results from a new speed test which found that "most" underperforming NBN services were – you guessed it – fibre-to-the-node connections. "These services never come close to delivering the maximum speed promised, because of either limitations with some FTTN lines, or connection issues such as in-house wiring faults," the report reads. According to the results of the report, fibre-to-the-premises customers get an average of 88 percent of maximum plan download speeds and 92 percent of upload speeds, compared to FTTN users, who get 79.6 percent and 77.3 percent respectively.

There's no doubt that FTTN is an inferior solution: we've known this for years. But the timing of this report is interesting, coming as it does in the lead up to an election which could occur as early as March. And Rudd's comments aren't the first time we've heard about Murdoch's interests in the NBN. In 2013, then Shadow Communications Minister Malcolm Turnbull wrote an unusual blogpost about how "the Coalition's plan for the NBN will bring the day of

reckoning [for Foxtel] much sooner."

Yes, that seems defensive. It is: it's in response to a Sydney Morning Herald opinion piece about News Corp's not-too-fond views of the NBN and its seeming fondness for the Liberal Party's FTTN compromise. Indeed, Murdoch had just recently publicly Tweeted about the NBN to his 736k global followers. "Oz politics!" he wrote in August 2013, in the lead up to a federal election which saw Tony Abbott beat Rudd's Labor government. "We all like idea of NBN, especially perfect for Foxtel. But first how can it be financed in present situation?"

It's no secret that the NBN is a highly politicised affair, a preposterously politicised one, given that it's essential infrastructure. Indeed, compared to 2013, the way we use the internet in 2019 is much more data-intensive. It's not enough, as one Coalition talking head suggested last year, for it to operate just as well as Netflix demands. This year's election will not be fought for the NBN, and the damage is done anyway. But don't expect the mildly-entertaining comedy of disasters to end any time soon. ■

END USER

Share your stories!

If you have an interesting story about technology users, their experiences and the issues that affect us all (whether funny or serious), email us at apcmag@futurenet.com. All correspondence becomes the property of APC and is subject to editing. Letters must include writer's full name, street address, suburb, state and phone number to be considered for print publication. Address and phone details will not be published.

Smartphones vs. Tablets vs. Chromebooks

The APC team considers the best ways to take the Internet with you.

You need the Internet, you need to get things done, and you need it in a convenient form, but what form does that wonder device take? Is it a tiny sliver of tech primed to explode in your pocket? A slightly bigger sliver of tech, ready to go bang in your bag? Or something laptop-shaped, but only partially laptop-ish? Bashing together three very different things is always difficult, but each category fills that connectivity niche nicely – and needn't break the bank.



Round 1

PRODUCTIVITY

This won't come as a surprise, but it's very hard to work efficiently on a smartphone. Even the largest phablets have a screen that's just too small to contain any significant portion of a document and an on-screen keyboard, and while the apps are there – analogs of the Microsoft Office suite, Google's collection, and everything in between – actually using them is another matter. The same can be said of tablets; if you really want to get something done on a keyboard-free device, you're going to have to juggle with Bluetooth peripherals and squint really hard. That said, there's slightly more screen real estate to work with on bigger devices, and certain examples (the iPad Pro, in particular) are uniquely suited to artistic pursuits in a way that no other device can match.

While the tools on a Chromebook are more limited than those of a full PC, and the power is far less, the laptop-shaped form factor lends itself much more sharply to getting things done. Just about every task can be completed with web-based apps, and (rickety) compatibility with Android apps means you'll likely be able to fill in any blanks if you run into a wall.

WINNER:
Chromebook

Round 2

MEDIA CONSUMPTION

It's hard to split our categories, because they each have their own advantages. A Chromebook can be placed on a surface, angled appropriately, and chuck out as many movies and online videos as you like while you lounge. But we'd have to list it bottom of the pile because, unless you invest a lot of cash in a Chromebook, you're going to be dealing with a barrel-bottom display – and throwing a thousand dollars at a Chromebook basically defeats the entire object.

Tablets give you that larger screen, and usually sport solid viewing angles – there's nothing better (apart, perhaps, from a massive TV) when it comes to curling up on the couch to watch something special. Load up a tablet with media before you travel, and it helps you pass the time in style. But is a tablet as strong as an LTE-equipped phone that can slide into your pocket? Not by a long shot. Podcasts, audiobooks, streaming radio – they're all best suited to a tiny device with headphones, and the negative of a phone's smaller screen doesn't beat the positive of its portability. Mobile media consumption on either of the other formats just isn't as convenient.

WINNER:
Smartphone

Round 3

ACCESSIBILITY

There are two meanings of the word "accessibility," and one is a synonym of "availability." That means there are two outcomes to this category, and two ways to judge our devices. Think about the phone, for example, that ever-present Internet-connected computer that's always there when you need to look at cat pictures or dodge robocalls. Top of the tree, perhaps, but do a little experiment: Pull your phone out of your pocket, open your messaging app, close your eyes, and write a message. Attempting the same trick with the tactile keyboard of a Chromebook will likely net you far better results.

If you need the assistance of accessibility features, you'll find them on just about every device worth its salt. These can vary a little depending on the exact hardware, but you'll almost certainly find high-contrast graphics modes, magnifiers, screen readers or select-to-speak functions, and dictation functionality on any model of any of these devices. The scales, really, are wobbling between the phone and the Chromebook, and the latter has more weight – that keyboard scores it extra points, and adds a sprinkling of additional disability aids along with it.

WINNER:
Chromebook



Round 4

PERFORMANCE

Again, this is a topic that depends on the precise hardware; each category has its low and very high-end devices. If you're spending \$60 on a dinky Amazon Fire tablet, you can expect some awful performance and sluggish response times. If you drop upward of \$1,000 on an iPad Pro, you'll get a far more sprightly interface. Cheaper phones and cheaper Chromebooks have the same problem; they're underpowered, built to hit a mark, and look nice in pictures. Lower-resolution screens, lesser processors, and skimping on RAM makes a big difference.

So, let's look at the higher end. Benchmarks don't help, as we're breaking down three separate worlds, making this more a holistic assessment. There is no blowaway Chromebook. The Pixel Slate, for all its bravado, is not a blowaway tablet, and even flagship Android phones have their niggles. The latest-generation iOS devices are – however you feel about their creators or their philosophy – by far the most responsive and pleasing slabs of mobile hardware, and for all the tightness of the iPhone, the A12X Bionic inside the 2018 iPad Pro is the processor to beat.

WINNER:
Tablet

Round 5

PRICE

Goodness, aren't phones expensive? Yes they are. And progressively more so. Not all of them – there's a constant bleed of fresh brands from China that seem to be pushing the boundaries without pushing their luck on your wallet – but, in general, phones are far more expensive than they should be because they're status objects first and functional second. We're almost not angry about it, either; that cash fuels a drive for innovation that is pushing technology forward.

The real contenders here are the other pair, and we need to make a judgment call. Tablets can be had very, very cheap, but Chromebooks come in at astonishing prices, given that they're essentially proper computers, at least if you ignore the hamstrung OS. Those devices that do hit that bottom line aren't always the best, but as we'd be far more likely to recommend an 11-inch Chromebook over a rickety 8-inch Android tablet, there's only one sensible choice. Do note, though, that shopping around at the right time can bag you full-bore Windows laptops for the same price as a low-end Chromebook – and that's a license to do more.

WINNER:
Chromebook

And the winner is...

The Chromebook is a great idea. We applaud Google's moxie in pushing forward a device with lower hardware standards and an OS that all but forces you online. It's a great way to tie people to Google's services, yes, but recent developments have made Chrome OS more flexible and viable as a standalone device. It's won the most categories in this subjective test, but does it win overall? No. Neither does the tablet bag the crown because, after all this time, there's only really one good brand of tablet to buy; and while we've avoided talking about PC tablets, we'd lump most of them in the same slightly wobbly category as Android tablets. Nobody's quite got it right after all this time, and PC tablets are generally just laptops in disguise anyway. The smartphone is our winner. You need a phone. You have a phone. That phone fits in your pocket, connects you to the sum of the world's knowledge, and keeps you entertained hour after hour, wherever you may be. As much as they try, the other two categories can't replicate that killer feature. ■



FROM \$2,899 | WWW.MSI.COM

MSI P65 8RE

MSI's prestige ultrabook is basically a GS65 in a silver suit, but is this professional powerhouse perfect?

If you loved MSI's 2018 GS65, but don't quite think you could get away with its gold grills in the office, you'll be jonesing for MSI's Prestige series P6 58RE. It's clear from the vent design and identical physical specifications that MSI has used the same chassis of the GS65 to build the new P65. This is not a bad thing. We do prefer the black, red and gold colouring of the GS65 to the plain silver P65, but the fresh all-white Limited Edition P65 might just be our favourite of the three.

Up front the MSI P65 has an Intel Core i7-8750H CPU and 16GB of RAM. The P65 comes in two variations locally: the silver P65 Creator 8RE, with a GTX 1060 (Max-Q), 60Hz FHD IPS display and a ludicrously small 256GB PCIe SSD, or the much more sensible limited-

edition white P65 8RF, fitted with a GTX 1070 (Max-Q), a 144Hz FHD IPS display and a far more reasonable 512GB PCIe SSD.

One of these devices we would recommend, the other... probably not. The main factor here is space. Once you use 100GB for the OS and another 50GB for apps, you'll be at critical capacity with just three games, a couple of videos and a handful of files. If you love juggling and rearranging your hard drive every day then go for it, for everyone else 256GB is not enough space for a gaming or professional laptop.

The P65 8RE can be reliably bought for \$2,899, but the MSI P65 8RF ranges in price from a not so great \$3,499 to the most common pricing of \$3,199 (and we even saw the P65 8RF going for as little as \$2,799 from one vendor).

The overall performance was within 5% of what we got for MSI's GS65 Stealth Thin in raw CPU benchmarks, which is unsurprising considering they share nearly identical components. We tested the silver P65 8RE with a GTX 1060 (Max-Q) GPU, while the GS65 has a GTX 1070 (Max-Q), so the 5-20% drop in gaming frame rates across our benchmarks was around what we expected.

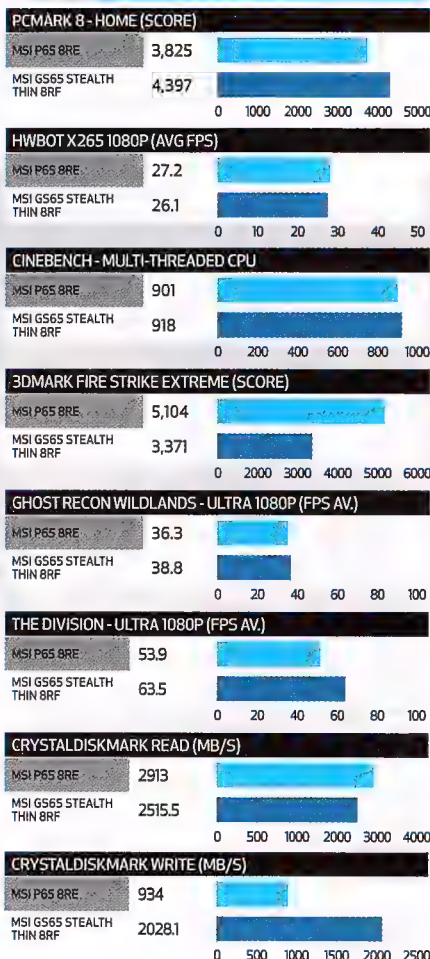
While the P65 8RE's read speeds were a bit faster, its write speeds of 934 MB/s were less than half what the GS65 scored, at 2028.1 MB/s. The GS65 uses a newer NVMe drive, allowing it to double the write speeds.

Battery life was also what we expected with the P65 lasting 3 hours and 53 minutes in the PCMark Home battery benchmark to the GS65's 3 hours and 40 minutes. This slight

bump in lifespan makes sense since both units have an 80Wh battery and the P65 uses a lower powered GPU.

The nicer looking design, 144Hz refresh rate, 512GB SSD and better GPU of the White Limited Edition P65 8RF means we would give it at least a mark above the P65 8RE's score here, if you can get it for a similar price. ■ Joel Burgess

LABS BENCHMARK RESULTS



Verdict

If you glimpse the Limited Edition White P65 8RF then bag it, but the P65 8RE has a couple of critical shortcomings that make it not such a sure thing.

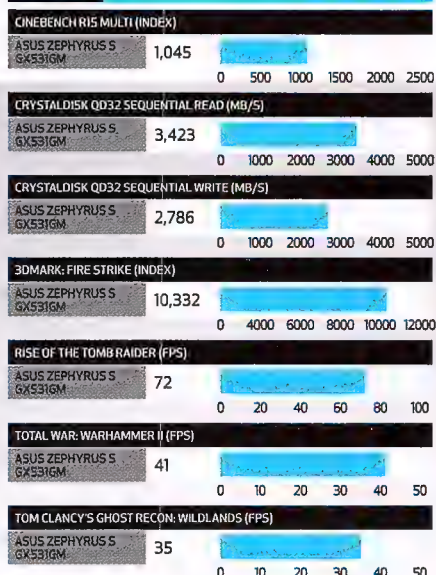




LAPTOP

\$3,099 | WWW.ASUS.COM/AU

LABS BENCHMARK RESULTS



Asus Zephyrus S GX531GM

The battle for ultra-thin gaming rages on.

It's time once again to present that most tricky proposition: the gaming ultrabook.

Here's an ultra-thin, seriously designed piece of gear that looks as capable of passing itself off in a boring meeting as it is at offering up a slice of gaming gateau. But can you really squeeze everything you need for gaming into a chassis that's less than 15mm thick? Let's find out.

This is actually an updated version of the GX501, with an eighth-gen 2.2GHz Core i7-8750H at its heart, and a 144Hz panel. This panel may lack the G-Sync cleverness of the original model, but as it has a lower-powered GeForce GTX 1060 pumping out the pixels, this is less of an issue, as you'll be hard pushed to hit the frame rates needed to make the most of Nvidia's screen-smoothing tech anyway.

The screen itself is a beautiful slice of what's now possible on laptops, and the fact that it's a 144Hz panel

means it's silky smooth in operation. This is an IPS-level screen with vibrant color reproduction and great viewing angles, and the decision to stick to Full HD, as opposed a higher resolution, works in its favor, both for usability in Windows and as far as that GPU is capable of driving.

A key part of the gaming proposition is the Armory Crate software, which lets you change the system profiles. The key idea here is that this enables you to throttle back the performance of the CPU and/or GPU in order to keep noise levels down, or alternatively ignore such niceties and go full bore. Normally, profiles have only a slight impact on performance/noise, but here they make a genuine difference.

For the most part, we're devotees of using the machine in Silent mode, which isn't quite silent, but it is notably quieter than Balanced or the white noise of the Turbo mode. Asus has

clearly spent a considerable amount of time honing the cooling here, and the fact that it has squeezed a top-notch CPU and a high-end GPU into such a thin chassis and actually made them usable is impressive. Having said that, don't be fooled into thinking this thing is above the laws of physics – in Turbo mode, it's really freakin' loud.

To give you an indication of the kind of impact this can have, 3DMark produced a score of 10,736 using the Turbo setting, while the same machine managed just 8,097 when running in Silent mode. For our main testing, we left the machine in Balanced mode, which garnered a score of 10,332 in that same 3DMark, which is only slightly off the pace of Turbo setting – although, to be fair, it was vocal in hitting that score.

If you're looking to use this as a gaming machine with the latest titles, you're probably going to want to invest in a good pair of

noise-canceling headphones. Alternatively, playing on Silent mode is a genuine option, and should still see you right, albeit at slightly lower settings and frame rates.

The build quality is generally excellent, with the CNC-milled chassis and lid producing a relatively heavy but solid-feeling device. The way the bottom drops down to aid airflow as you open the screen is particularly pleasing. There is one area that isn't so impressive – the plastic at the bottom of the screen panel is feeble in comparison to the rest of the machine, and flexes to the touch.

Alan Dexter

Verdict

Solid design; ultra-thin; vibrant screen; quiet in Silent mode. Loud in Turbo mode; GPU lacks real grunt.





LAPTOP

FROM \$2,799 | WWW.DELL.COM

Alienware m15

Alienware's first real thin and light gaming laptop has been a long time coming, but is it a little over cooked?

There's a big shift in overall design of the 2018 Alienware m15 from last year's Alienware 15. Cuts to the m15's footprint have eliminated the former's unique rear vent design, which jutted out well past the screen hinge, transforming the new model into a far more predictable gaming laptop shape. The 36.3 x 27.5 x 2.1cm, 2.2kg chassis of the m15 is also 1.3kg lighter, 2.6cm narrower, 3cm shallower and 4mm thinner than its predecessor. We actually prefer the overall look of the original and while you could argue that a more compact design can hinder thermal efficiency, the Alienware 15 had surprisingly bad thermals, with the Core i9 CPU regularly spiking to 100-degrees C, so there's not much point. Generally Alienware

offers a range of CPUs on its gaming laptops, from Core i5s through to an overclockable Core i9 processor, but the 2018 m15 comes with only one CPU locally – presumably because the 2019 m15's that Dell announced at CES in January aren't too far off. As you might expect the Intel Core i7-8750H sits at the heart of the the current m15, supported by either 16GB or 32GB of RAM. This is complimented by either a GTX 1060 or a GTX 1070 (Max-Q) GPU; a 128, 256 or 512GB M.2 SSD; and a 1TB HDD; for what is a very standard configuration overall. The range has been made with a FHD 144Hz panel, but Dell don't seem to sell this model in Australia, deferring to either the 60Hz 1920 x 1080p or 4K 60Hz IPS displays. While the raw performance of the Alienware 15 is

impressive with scores of 1153 on Cinebench's Multi-threaded CPU test (the second highest we have on record for that CPU), it isn't perfect across the board. In PCMark's Home (accelerated) benchmark it was the second worst performing of the 12 devices we have on file that used a i7-8750H CPU. Overall, the m15 had between 7 and 30% lower performance across CPU heavy tasks than the Core i9-8950HK Alienware 15 from last year. Since the GPU has moved to the more efficient Nvidia 1070 Max-Q GPU (from a regular GTX 1070) you see a similar 15 to 18% drop in overall framerates on ultra 1080p settings for games like, *Far Cry Primal* and *Ghost Recon Wildlands*. While the Max-Q cards to take a hit in performance, the power draw is much lower meaning you should get a

decent battery life kickback if all things are held the same. The m15 drops the battery capacity from 97Wh down to 60Wh, which gives it a 1 hour and 27 minute lifespan in PCMark's Home Battery accelerated. This is the worst result we have on file and is over an hour less than the Alienware 15. Fortunately battery life is much better for less demanding tasks, with the m15 netting a respectable four hours and 5 minutes in 1080p movie playback tests. ■ Joel Burgess

Verdict

This device feels like a placeholder for the already announced 2019 Alienware m15s with 20 series Nvidia RTX GPUs.





SSD

\$769 (2TB), \$385 (1TB), \$199 (500GB), \$139 (250GB) | WWW.SAMSUNG.COM/AU/

Samsung 970 Evo Plus

Samsung retakes the lead in the great SSD race.

We never expected to see a new NVMe solid-state drive (SSD) from Samsung this soon – especially with the 970 Evo and 970 Pro launching just last April – but here we are looking at the new Samsung 970 Evo Plus. While it might seem like a minor upgrade unworthy of a fully numbered sequel, the Samsung 970 Evo Plus is a worthy successor, with the fastest speeds and some of the lowest prices seen on its NVMe SSD products.

The entire NVMe SSD world is engaged in something of a race to the bottom to offer the cheapest and fastest storage, and it seems Samsung has had to bend to market dynamics. Samsung has brought its prices down across the board. Undoubtedly, these new price cuts are a result of WD entering the market with the affordable WD

Black SN750. Although it might seem like the 970 Evo Plus wasn't revolutionary enough to earn the name 980 Evo, it's the first drive from Samsung to introduce its new 96-layer V-NAND. The new form of memory is basically designed to stack higher, and reach higher speeds.

Specifically, the 970 Evo Plus is designed to write at 3300MB/s sequential writing speed – far outpacing the 970 Evo, which maxed out at 2,500MB/s, and even the 970 Pro's top 3,300MB/s – on sequential writes. Sequential writes remain at 3,500MB/s, but this is basically the gold standard among the fastest SSDs on the market. This new 96-layer V-NAND is especially significant as it makes Samsung one of the only companies to speed up its SSDs with new silicon, rather than just updated software. On paper, the 970

Evo Plus exceeds the specs of the WD Black SN750, which runs at up to sequential read and write speeds up to 3,470MB/s and 3,000 MB/s, respectively.

If you were hoping for some competition when it comes to the warranty, unfortunately (or fortunately) WD and Samsung offer the same five years of coverage and nearly identical total terabytes written endurance as seen above. The only difference is the 250GB 970 Evo Plus is rated for 150TBW, whereas the 250GB WD Black SN750 rated for 200TBW.

The Samsung 970 Evo Plus' 96-layer V-NAND isn't just for show, this drive propels past both its predecessor and Samsung's previous star performer, the 970 Pro.

Considering that the Samsung 970 Evo Plus is meant to be a value-oriented, consumer SSD, we're really pleased by how

well it performed – even outperforming the enterprise-leaning 970 Pro.

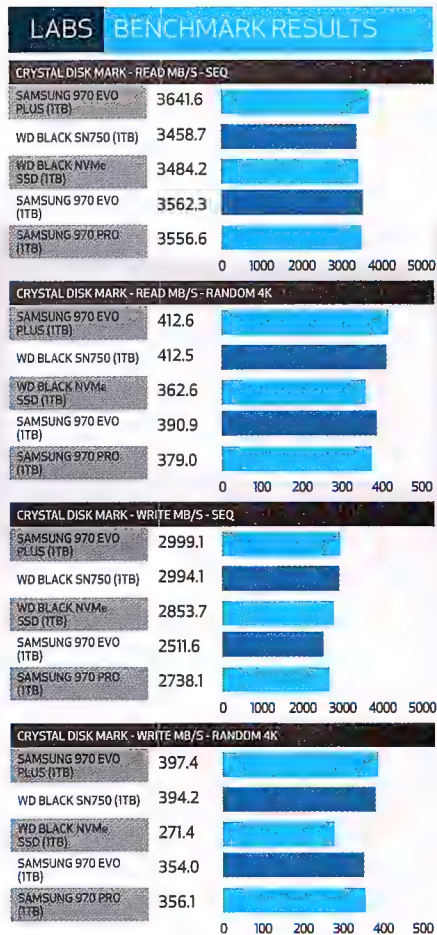
The only mildly disappointing thing about the drive is that it couldn't maintain its rated 3,300MB/s sequential write speed under load.

As NVMe SSDs just keep getting faster and cheaper, it was time for Samsung to respond in kind – and it has done so, with its best drive yet. The Samsung 970 Evo Plus has reclaimed the throne as the best SSD, coming in at reasonable prices and delivering the best overall performance. ■

Kevin Lee

Verdict

Under assault from cheaper, faster NVMe solid-state drives, the Samsung 970 Evo Plus proves why it's the king.





SSD

\$399 | WWW.SAMSUNG.COM/AU/

Samsung 860 QVO 2TB

Another nail in the HDD coffin?

For years we've been talking about how SSDs are encroaching upon the mechanical hard drive market. While we're a long way from calling the death of the HDD, the advent of 4-bit per cell NAND is a big step towards addressing the advantages held by hard drives: price and capacity. QLC (Quad Level Cell) NAND has been seen in a couple of NVMe drives, but the Samsung 860 QVO 2TB we have on hand for review is the first QLC SATA SSD. It's priced very aggressively and looks to be a solid choice for users looking for a good value and/or high capacity SSD.

QLC NAND is inherently slower and has lower endurance than TLC NAND found in the majority of consumer SSD's. It offsets this with increased data density which leads to lower prices and higher capacities. With this in mind Samsung

has taken the smart step to leverage these advantages and produce a value-oriented SSD rather than follow the curious decisions of other QLC makers to launch with pricier NVMe models. SATA is still ubiquitous, and this seems to be good business decision. QLC is easily good enough to destroy hard drives, performance-wise, to go along with their fast access times, low power consumption and zero noise levels. QLC is here to stay and we expect some interesting models to appear throughout 2019.

The 860 QVO is a standard 2.5in SATA 6GB/s SSD. It's available in 1TB, 2TB and 4TB capacities. It uses Samsung's highly regarded MJX controller along with a 2GB DRAM buffer (for the 2TB drive). There's 256-bit AES hardware-based encryption support too. We're a little disappointed to have a three year warranty

as the endurance rating for the 2TB model is quite good at 720 Terabytes Written.

Performance-wise, the drive is able to max out the SATA interface in sequential testing. That will be the case for most common use scenarios, but Samsung implements what it calls Intelligent TurboWrite, which assigns an unused portion of the drive to run in SLC mode which boosts performance under light loads. The 2TB model allows for up to 78GB of this cache, so if you're writing more data than that at once, expect significant slowdowns in sequential performance. Synthetic testing showed the 2TB QVO to be surprisingly good, though random read and write performance was nothing to write home about.

The Samsung 860 QVO is an exciting SATA SSD market entrant. It's all about value with the 2TB model

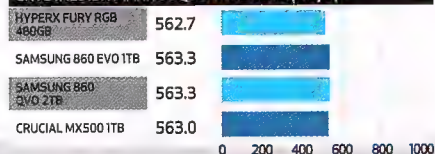
coming in at \$399. The sweet spot 1TB model comes in at \$199 making it a seriously compelling option for mainstream users. In general use it matches other mainstream SSDs in performance, but it will temporarily drop to HDD-like speeds once you use up all of the Intelligent Cache.

Users looking to banish a HDD from their system or a gamer looking for a bigger library drive will find a lot to like here. Big capacity SSDs are finally starting to become serious options for mainstream users and Samsung is leading the charge with the 860 QVO. ■

Chris Szewczyk

LABS BENCHMARK RESULTS

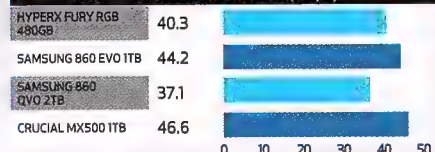
CRYSTALDISK MARK SEQUENTIAL READ (MB/S)



CRYSTALDISK MARK SEQUENTIAL WRITE (MB/S)



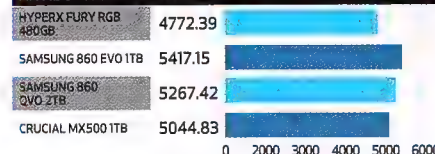
CRYSTALDISK MARK RANDOM 4K READ (MB/S)



CRYSTALDISK MARK RANDOM 4K WRITE (MB/S)



ANVIL STORAGE UTILITIES



Verdict

The Samsung 860 QVO offers superb value, though it does have its limitations under very heavy loads.





PORTABLE DISPLAY

#599 | WWW.ASUS.COM/AU

Asus ZenScreen Go MB16AP

Add a second screen to your portable workstation.

A portable display is a rather niche proposition, but if you are one of the few that needs a multi-screen setup that can go anywhere, or a big screen to display your smartphone, then Asus's ZenScreen Go should be in your shortlist. The ZenScreen Go has the same honed metal chassis as its ultrabook brethren and is one of the only portable displays to really minimise the bezels. Combine this with a sleek magnetic folio case and smartphone sized charging cable and you have one of the best looking portable displays available.

The 15.6-inch Full HD display features a 7800mAh Li-Po battery which will last four hours on peak brightness settings. This will stretch to almost a full working day if you can lower the brightness or live with the slightly duller 'Eco' display settings. The MB16AP uses a USB Type-C

interface, which makes it compatible with most new ultrabooks and many flagship smartphones. It also includes a USB C to A adaptor. This interface also offers the ability to run power and video through the one cable, minimising clutter and keeping the display running for longer.

With a peak brightness of 220nits the screen isn't going to be setting any luminance records, but this is a good level for a portable display, offering ample brightness to work in a bright room without being overly demanding on the battery. Combine this with an 800:1 contrast ratio and the wide viewing angle offered by the IPS panel and this screen looks good enough to sit alongside any ultrabook on the market.

While it's important for a portable display to look great, it's perhaps equally as important for the stand to support the screen in a wide variety of conditions – since the space and overall stability of the

surfaces you are trying to use it on will vary considerably when travelling. The MB16AP's foldable folio can contort into four display positions that each offer varying degrees of support, ranging from barely adequate to extremely fragile. The magnets on the folding support structure aren't overly robust and all of them require a perfectly flat surface to work without toppling, and even then a small bump like a train slowing down or some mild turbulence would be more than enough to topple it. If you bring along the included ballpoint pen then you'll get a 5th screen position by slotting it into the spacer hole in the bottom right of the display. This unusual arrangement is, surprisingly, more sturdy than the stand, but still requires a perfectly flat surface to work.

Screens generally aren't a particularly expensive PC component, so \$599 for a 15-inch 60Hz FHD display

with no special colour calibration seems particularly steep. If you can live without the battery then the ZenScreen MB16AC portable display comes in at \$429 and it's not hard to find portable SD screens, at this size, going for as little as \$200. If however, you absolutely need that battery, there isn't much in the way of alternatives.

This sleek, fully-portable monitor has enough tech to justify the lofty price – we just wish Asus spent more time on engineering a better support mechanism. ■

Joel Burgess

Verdict

A very specific monitor for specific uses, that comes with specific drawbacks.





Nvidia RTX 2060

Is this the RTX sweet spot?

PC gaming enthusiasts with deep pockets have had access to Nvidia's Turing RTX graphics cards for several months now. They're good cards, though their steep price tags keep them well outside the reach of the majority of PC gamers. Most of us just aren't interested in dropping \$800+ on the (until now) most affordable RTX card – the RTX 2070. Widespread ray tracing adoption will never happen at those prices. The RTX 2060 is now the cheapest RTX series card, though calling a \$600+ card cheap is a misnomer for sure.

The RTX 2060 is the successor to the GTX 1060 in pretty much name only. The number of Cuda cores has increased from 1280 to 1920, memory bandwidth

increased from 192GB/s to 336GB/s and of course the price has gone up by a hefty amount too. That's before mentioning the RTX features.

It's those RTX ray tracing features that Nvidia has bet the farm on. The die-space-hogging RT and Tensor cores are at the heart of what Nvidia is trying to achieve with Turing. While the potential is there, we are yet to see it outside of a limited number of demos and titles.

Now that we have the hardware, it's time for the developers to start implementing the tech in software. *Battlefield V* is among the first games and many more are coming that include ray tracing and other features like DLSS. While ray traced lighting effects look gorgeous, is it truly a game changer? Will the Deep

Learning focused Tensor cores deliver on their potential? We look forward to seeing whether ray tracing is the real deal or not.

The RTX 2060 uses the TU106 die, the same as the one powering the RTX 2070, though it has some of its cores disabled. It comes with 1920 CUDA cores, 240 Tensor cores and 30 RT cores. This compares with the 2304 CUDA cores, 288 Tensor cores and 36 RT cores of the full TU106 GPU. It comes with 6GB of GDDR6 memory over a 192-bit bus. The TDP of the Founders Edition RTX 2060 is a perfectly reasonable 160W. That's not bad at all for a graphics card with a large 445mm² die.

As was the case with the RTX 2070, the 2060 doesn't support NV-Link, so gaming is limited to a single card.

When evaluating the RTX

2060, we can largely repeat what we said when covering the RTX 2070: while the forward looking features are very impressive, the jury is still out on whether ray tracing is a game changer or not. Current game performance is the differentiator that matters most. The price increase over the GTX 1060 places the 2060 against the likes of the well-established RX Vega cards and popular previous generation GTX 1070 and 1070 Ti. If it can beat those cards whilst being cheaper, then we're looking at a winner. Throw in the RTX features as a cherry on top instead of the primary selling point and the RTX 2060 looks like a genuinely compelling buy. ■ Chris Szweczyk

RTX 2060 BENCHMARK RESULTS

	GHOST RECON WILDLANDS (VERY HIGH PRESET)						SHADOW OF WAR (ULTRA PRESET)			3D MARK		TEMPERATURES °C	
	1920X1080		2560X1440		3840X2160		1920X1080	2560X1440	3840X2160	FIRESTRIKE	FIRESTRIKE EXTREME	IDLE	LOAD
	MIN	AVG	MIN	AVG	MIN	AVG	AVG	AVG	AVG				
NVIDIA GEFORCE GTX 1080	82.18	95.77	59.52	72.36	32.51	41.92	98	67	39	19498	9916	39	74
NVIDIA GEFORCE GTX 1070	67.80	77.63	48.37	58.62	26.24	33.93	78	54	31	16188	8208	37	73
NVIDIA GEFORCE GTX 1060 6GB	51.49	61.21	35.68	43.88	18.88	24.63	56	38	22	11496	5947	33	73
AMD RADEON VEGA 56	63.60	77.32	35.25	58.94	26.87	34.79	84	57	35	16721	8439	36	71
NVIDIA GEFORCE RTX 2070 FOUNDERS EDITION	87.74	100.87	63.49	76.76	34.97	45.27	115	80	48	20929	10673	36	72
NVIDIA GEFORCE RTX 2060 FOUNDERS EDITION	76.69	88.69	56.32	67.45	28.49	38.50	94	66	39	16583	8611	36	71
MSI GEFORCE RTX 2060 GAMING Z 6G	79.51	93.35	59.94	68.25	30.33	39.43	97	70	40	16956	8722	38	68



GRAPHICS CARD

\$599 | WWW.NVIDIA.COM.AU

NVIDIA GeForce RTX 2060 Founders Edition

The RTX card the market needs.

Finally we have a somewhat affordable RTX card! RTX generation Founders Edition cards are a big step forward compared to their blower cooler equipped ancestors. The card is surrounded by an aluminium shroud including a solid backplate that looks great, helps with cooling, and adds rigidity to the card.

The RTX 2060 Founders Edition has an excellent array of display outputs, with two DP 1.4 connectors, a single HDMI 2.0b, USB Type-C and a DVI-DL port. The premium MSI can't match that.

The Founders Edition doesn't have the cooling surface area of the MSI, so it can't match its boost clocks or the essentially silent noise levels. That's to be expected though given its lower spec.

What really matters is not forward-looking ray tracing support, but how it performs in the here and now. This is where the RTX 2060

impresses. It destroys the GTX 1070 and draws very close to the GTX 1080. This alone makes it a recommendation given its impressive price/performance. Finally Pascal can be considered obsolete, at least in this price range and higher.

The RTX 2060 Founders Edition can't really be considered a GTX 1060 replacement at this price, but that's ok given that it's actually closer to the 1080 in performance. The RTX 2060 is the first RTX series graphics card that we unequivocally recommend. It offers good bang for buck, performs better than previous generation cards at this price point and is relatively future proof. ■

Chris Szewczyk

Verdict

It's not quite mainstream at this price, but the RTX 2060 provides great performance.



GRAPHICS CARD

\$679 | AU.MSI.COM

MSI GeForce RTX 2060 Gaming Z 6G

Faster, cooler, quieter and better looking.

MSI's RTX 2060 Gaming Z is the first custom RTX card we've had in our labs, and like MSI's Gaming cards usually are, it's an improvement over the Founders Edition in almost every way.

The MSI Gaming Z is solidly built yet remains quite compact compared to the very large Trio Gaming cards. There's a solidly machined backplate and no high end GPU in 2019 would be complete without an attractive dose of RGB lighting. The MSI features three DP 1.4 ports along with a single HDMI 2.0b port though curiously no Type-C port. The card requires just the solitary eight pin power connector. Particularly impressive is the boost clock of the MSI which increases to 1830MHz, a nice bump over the 1680MHz of the Founders Edition card.

MSI's Twin Frozr coolers are highly regarded with a good combination of cooling performance and low noise levels and the 2060 Gaming

Z cooler is no exception. The Gaming Z was able to hold boost clocks well above 1900MHz whilst remaining effectively silent.

The 2060 Gaming Z is another highly recommended card from MSI. Its great looks, build quality, and performance that brings it within striking distance of a GTX 1080 whilst maintaining low noise levels make it an easy recommendation. The price is a good \$80 more than a Founders Edition or even a card like MSI's own 2060 Ventus, so whether the premium is justified may come down to whether you want to show it off in a windowed case.

■ Chris Szewczyk

Verdict

MSI's 2060 Gaming Z is a major improvement over the FE card, but it comes with a hiked price.





MOTHERBOARD

#929 | WWW.MSI.COM

MSI MEG Z390 Godlike

More glitz than the Vegas Strip.

We've spoken a lot about manufacturers turning away from gaming motifs, jazzy lights, and pointy angles in favor of sleeker designs, a more premium feel, and a better quality of product.

MSI's MEG Z390 Godlike didn't seem to catch that memo. The layer of over-the-top glam adorning this bulky E-ATX beast was enough to make even our experienced selves take a step back, aghast. From the LED-dotted infinity mirror on the rear I/O cover to the vertically aligned OLED display showcasing the MSI dragon fighting some ninjas on startup, to the huge drake motif on the bottom chipset perpetually glowing with rainbow lighting, everything about this screams *gauche*.

There's no subtlety at all. That touch of class we find from the likes of Asus is absent. It's as if MSI saw the latest Formula, and said, "We want that, but x10."

Which leads us to the slight niggles that is

performance. Or lack thereof. We get it: auto-overclocking processors, especially ones as toasty as Intel's Core i7-8700K, isn't a good thing, but it's hard to deny the appeal of that extra performance. Compare this to the Hero, and you lose out by 100 points in Cinebench, nearly 4fps in X264, 10 seconds in Fry Render, and 2ns in memory latency at stock. Power draw is much lower here, with a 26W saving compared to the Hero, but it's not enough for us to start raving about it.

This is meant to be MSI's best and brightest componentry baked into a fine backbone of a motherboard, but we're just not seeing it. Take the power delivery: we're talking twin eight-pin EPS, sitting alongside an 18-phase VRM design (which is actually a 16-phase design in reality). Sounds great on paper, but how does it translate to overclocking? Well, our minimum 5.0GHz

stability benchmark test achieved a mundane 1.29V versus the Hero's 1.22, and the maximum overclock we managed was 0.1GHz lower than anything we'd achieved prior. Perhaps it's down to Asus supporting a stronger BIOS than MSI, but there really isn't a lot here to compliment.

There must be some positives, surely? Well, connectivity is extensively supported. There are three M.2 slots, with dedicated heatsinks, two internal USB 3.1 headers, two USB 3.0 headers, six SATA 6Gb/s, one U.2 connection port (for the 0.001 percent of the market with a device capable of plugging into it), and two USB 2.0 headers. You also get nine PWM fan headers, one AIO pump header, and a waterflow header. There are three RGB headers on the board, too, in case you run out. Plus, there's our all-time favorite JFP1 unmarked header for your front panel connectors. The one saving grace is the full-fat audio solution, but there's a lot

of fluff here, and not a lot of substance. The rear I/O is seemingly empty in contrast.

Ultimately, MSI's MEG Z390 Godlike tries too hard to be something it's not. The gaming motifs are tired, the LEDs are unnecessary, performance is acceptable at best, and the price is simply absurd. Even the dedicated audio isn't enough to convince us of its value. That's a shame, because MSI could be so much more than it is today – if only the company would take a step back, and try to establish exactly what its market should be.

■ Zak Storey

LABS BENCHMARK RESULTS

CINEBENCH R15 MULTI (INDEX)

MSI MEG Z390 GODLIKE	1,424
ASUS MAXIMUS X HERO	1,522

CRYSTALDISK QD32 SEQUENTIAL READ (MB/S)

MSI MEG Z390 GODLIKE	548
ASUS MAXIMUS X HERO	551

CRYSTALDISK QD32 SEQUENTIAL WRITE (MB/S)

MSI MEG Z390 GODLIKE	523
ASUS MAXIMUS X HERO	513

POWER DRAW IDLE/LOAD (WATTS)

MSI MEG Z390 GODLIKE	50/310
ASUS MAXIMUS X HERO	65/336

TOTAL WAR: WARHAMMER II (FPS)

MSI MEG Z390 GODLIKE	56
ASUS MAXIMUS X HERO	56

MAXIMUM OC ACHIEVED (GHZ)

MSI MEG Z390 GODLIKE	5.0 @ 1.29V
ASUS MAXIMUS X HERO	5.1 @ 1.32V

Verdict

Crazy price; under-performer; garish design; ill-implemented OLED display; poor overclocking.





MOTHERBOARD

\$285 | WWW.ASROCK.COM

ASRock X399 Phantom Gaming 6

A high end desktop board without the high end price.

AMD's Threadripper CPUs are undoubtedly high end. Thus, accompanying X399 motherboards are generally pricey compared to the mainstream AMD and Intel platforms because they are complex. All those PCIe lanes, quad channel memory, huge socket and expansive connectivity means X399 motherboards will never be cheap. Or will they? ASRock has gone and done it. The Phantom Gaming 6 is a high end motherboard that comes in at just \$285. Straight up - that's dirt cheap.

ASRock has always had a reputation for producing well-featured motherboards without exorbitant price tags, and at a glance the Phantom Gaming 6 follows this trend. Gone is the Fatal1ty branding. The Phantom Gaming brand now covers ASRock's gaming

motherboard and AMD GPU product lines. It's important to note that the board only supports 180W Threadripper CPUs, meaning you cannot use the WX processors. As the Phantom 6 is a gaming oriented board, that shouldn't be a problem.

The board is well stocked with connectivity options. The three PCIe slots all run at 16x when fully populated. You get eight SATA 6GB/s ports and three M.2 slots, all of which run at 4x. One of them comes with a heat spreader. That's one of the beauties of Threadripper: there's enough lanes for everything. About the only notable omission is Wi-Fi, though there is an E-key M.2 slot for adding a Wi-Fi card should you need it.

The rear I/O is packed with two USB 3.1 Gen 2 ports (Type-A and Type-C) and eight USB 3.1 Gen 1 ports. That should cover most use cases. The attention

grabbing feature is the inclusion of 2.5Gbit LAN. It's powered by a Realtek Dragon RTL8125AG controller which is a very welcome addition to the motherboard space. Hopefully this means we are finally getting close to sending Gigabit back to the 1990s where it belongs. Well done ASRock! There's an additional Intel I211AT controlled Gigabit LAN port too. Finishing it all off is a PS/2 port and the standard audio ports.

Performance is very strong as expected, particularly in applications that can make use of all the multithreaded grunt on offer. Gaming can still be hit and miss, though you can enable Legacy Compatibility Mode in the Ryzen Master software if your game scales poorly with a high core count CPU. With that simple tweak, game performance will be similar to a Ryzen 7 2700X.

The ASRock X399 Phantom Gaming 6 is a

well-rounded board that's well suited to either productivity or play. If you're primarily a gamer using a high refresh rate monitor then the mainstream platforms offer better value and in some cases better performance. If you're gaming with lots of eye candy then the difference shrinks to basically nothing. Threadripper is still best with highly parallel workloads though, and if you can make use of 12 or 16 cores then the Phantom Gaming 6 is a sensible option that comes recommended. At around \$285 at the time we went to print, it's an absolute steal, too. ■ Chris Szewczyk

LABS BENCHMARK RESULTS

3DMARK FIRESTRIKE SCORE

INTEL CORE I7-8700K	22,643
AMD RYZEN 7 2700X	20,737
AMD RYZEN THREADRIPPER 2950X	23,370
ASROCK X399 PHANTOM GAMING 6 (2950X)	23,873

CINEBENCH 15 MULTI-THREAD SCORE

INTEL CORE I7-8700K	1,411
AMD RYZEN 7 2700X	1,782
AMD RYZEN THREADRIPPER 2950X	3,010
ASROCK X399 PHANTOM GAMING 6 (2950X)	3,069

CINEBENCH 15 SINGLE-THREAD SCORE

INTEL CORE I7-8700K	194
AMD RYZEN 7 2700X	178
AMD RYZEN THREADRIPPER 2950X	175
ASROCK X399 PHANTOM GAMING 6 (2950X)	175

GHOST RECON: WILDLANDS 1080P, LOW, AVG FPS

INTEL CORE I7-8700K	180.49
AMD RYZEN 7 2700X	167.03
AMD RYZEN THREADRIPPER 2950X	163.22
ASROCK X399 PHANTOM GAMING 6 (2950X)	163.11

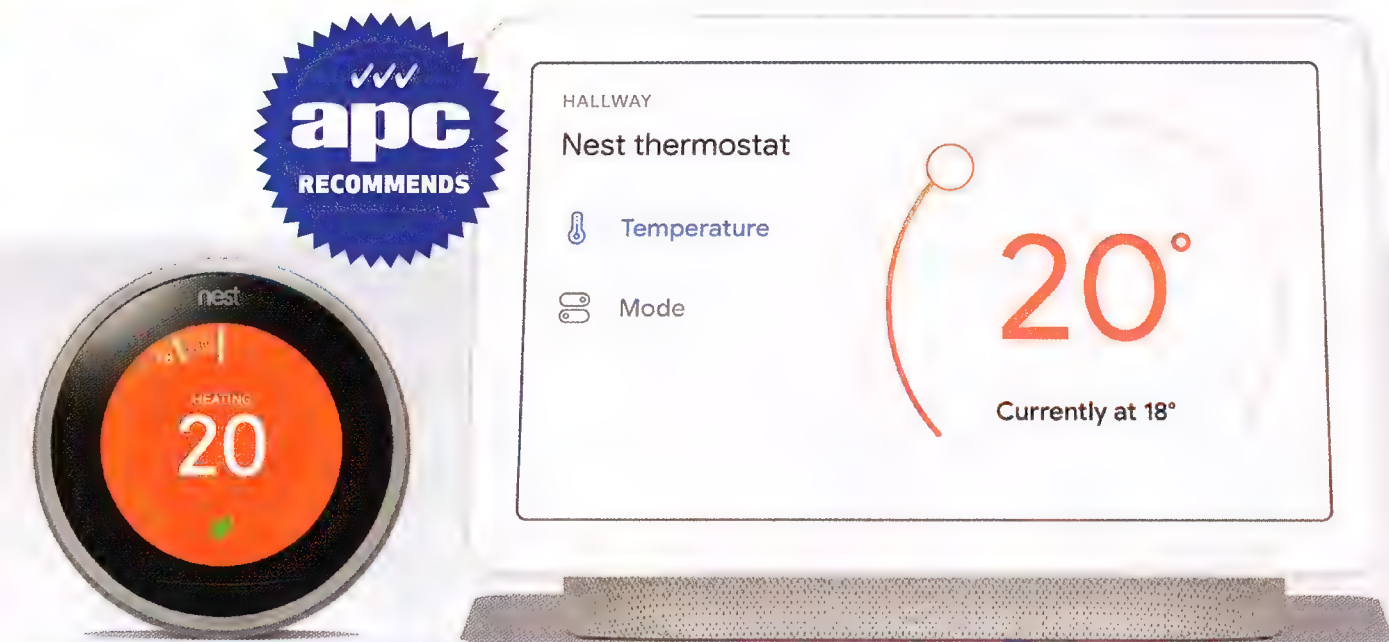
7ZIP MILLION INSTRUCTION P/SEC

INTEL CORE I7-8700K	40,378
AMD RYZEN 7 2700X	46,521
AMD RYZEN THREADRIPPER 2950X	81,250
ASROCK X399 PHANTOM GAMING 6 (2950X)	81,433

Verdict

Threadripper may be a high end platform, but this ASRock comes without the HEDT price.





SMART HOME

#219 | WWW.GOOGLE.COM

Google Home Hub

Cheaper than an Echo Show and, arguably, even better.

Google, Amazon and (to a lesser extent) Apple are all vying to take control of the next big thing in tech – the smart home and the associated products and services that come with it, with the second-generation Amazon Echo Show and the new Google Home Hub being just two of the latest devices to tempt you into joining their particular ecosystems.

The similarities between the Amazon Echo Show and the Google Home Hub are certainly uncanny, from form factor to features – even some commands sound the same once you change the word “Alexa” for “Hey, Google”.

The result is a device you feel like you’ve used before, yet Google’s version has some distinguishing features, like the auto-updating Google Photos gallery and a Home View that shows your smart home at a glance, all tied together by Google Assistant – the company’s answer to Microsoft’s Cortana.

PRICE AND AVAILABILITY

Google Home Hub is available now for \$219, which is \$130 less than Amazon’s second-gen Echo Show, although the latter has a larger display, a louder speaker and a camera for video chats, whereas the Home Hub does not.

DESIGN

At just 178.5x118x67.3mm, the Home Hub is surprisingly small. It’s so small the HD screen, at seven inches on the diagonal, is about the size of a large phone or small tablet while the base is so petite you could easily pick it up and place it in the palm of your hand.

The aesthetic is rounded out by a colourful bezel that matches the fabric-covered base and comes in four colours: pink, black, white and baby blue. Around the back you’ll find a power input, volume control and mic mute toggle – and that’s all there is to it.

While the Home Hub eschews a camera – chiefly

for privacy reasons – it offers a welcome alternative in the form of an Ambient EQ light sensor. This automatically adjusts the display’s brightness levels, according to the amount of ambient light in a room, but also changes the colour temperature and even switches the display to clock mode when it’s time for you to go to sleep. In practice, the speaker dials down the blue light output when it’s on your bed stand at night-time, before automatically turning the display down to near invisible levels when you turn out the lights. Conversely, if you put it next a window in broad daylight, it’ll dial the brightness back up, though it will top out at 400 nits.

SETUP/GOOGLE ASSISTANT

Before you start your smart home odyssey, you’ll need to set up your new device by downloading the Google Home app to your iOS or Android phone or tablet.

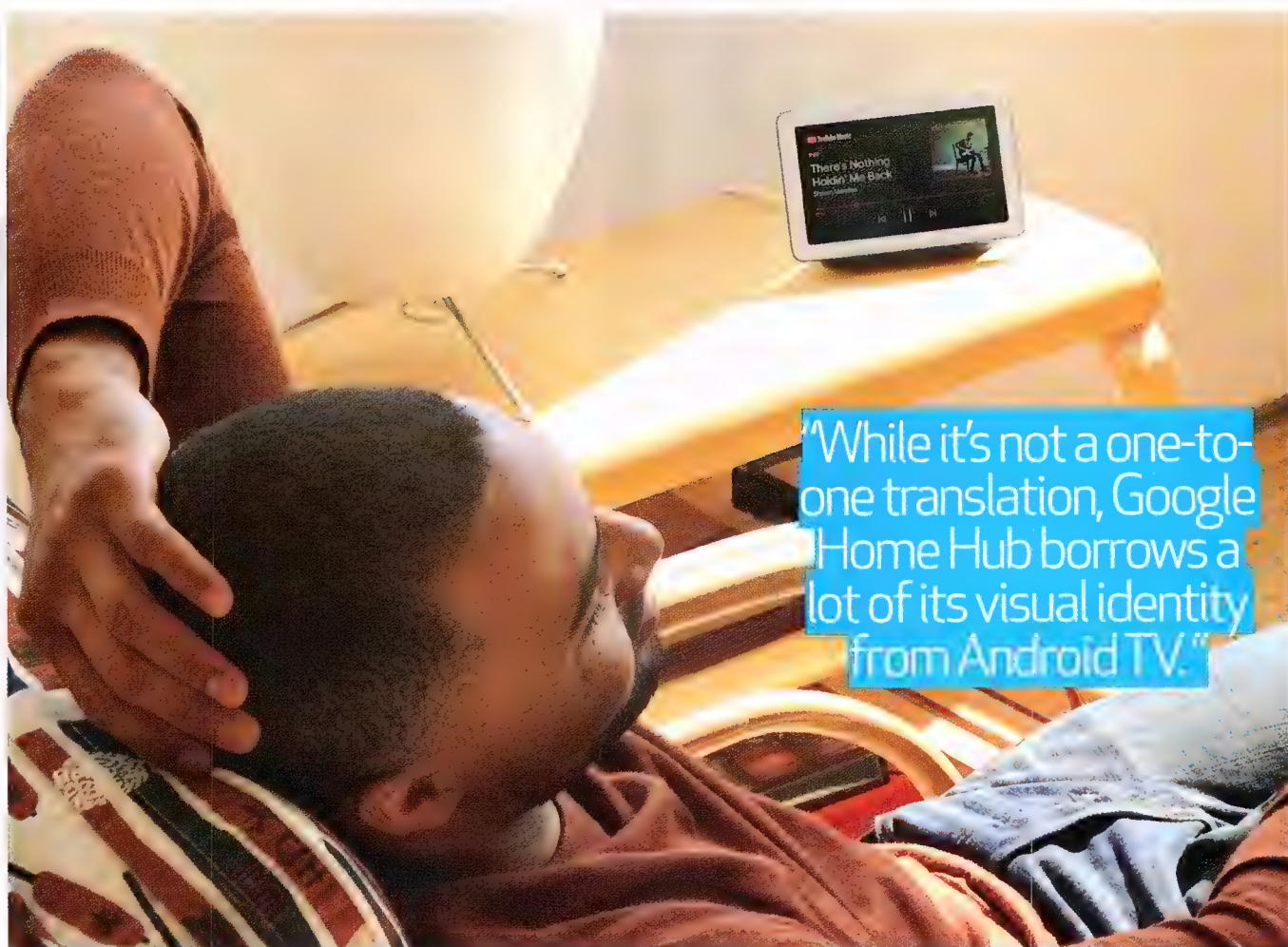
Once done, tap the ‘+’ icon under Home, and the app will search for any nearby Made by Google device. After a short pairing process you’ll need to select which room the Hub is located in as well as add any additional smart devices.

The setup process only takes a few minutes and the app works with over 5,000 smart devices from over 400 companies, including Sony, Philips Hue and Nest.

Google Assistant also works with a huge range of apps and services, including Spotify, HBO Now, Uber, ESPN and, of course, Google mainstays such as Google Calendar and Google Play Music. You’ll also find YouTube, and YouTube TV.

PERFORMANCE

While it’s not a one-to-one translation, Google’s Home Hub borrows a lot of its visual identity from Android TV. Swipe right from the screensaver and you’ll see large information cards that display items like your calendar, local



weather, music and video recommendations.

Ask Google Assistant for help or information, and all these things will disappear. What replaces them will depend on your inquiry. Ask Google Assistant for location information and it will serve up a map, contact info, reviews and descriptions of those places, while asking about a movie will bring up information on its cast. Click any of these cards and you'll be drawn deeper down a rabbit hole where you can see even more information. It's hard to believe that Google has found a way to visually represent every search term on the planet and yet, for nearly everything we searched for, there was usually at least an image associated with the search and some basic information to go along with it. And it's not just Search that receives a visual update – YouTube, Google Photos and Google Maps have been optimised

to offer relevant audio and video feedback based on your voice search commands.

Using YouTube on the Home Hub is both good and bad. If you know what you're looking for, you can ask Google Assistant to help. If your search requires more digging, things can get hairy. At most, the Home Hub will display three videos at a time, which means it might take a few minutes to find what you're looking for, meaning it's often easier to open your PC's web browser and search there instead.

It must be said that Home View, the user interface setting that shows every connected device in your home, Ambient EQ and Google Photos screensaver are, by far, the most innovative features. They're clear, fun and functional, and add solid functionality to what could've been a 'me too' product.

Where the Home Hub

shines a little less brightly is in the audio-visual department: YouTube videos don't look their best on the Home Hub's 7-inch screen and audio, while powerful enough for a song or two while washing the dishes, doesn't have the clarity or range to do justice to your music collection. There are ways to make both these problems slightly less of an issue, but largely you're stuck with something that just wasn't meant to be your primary way to watch shows and listen to songs.

SUMMARY

While the Google Home Hub isn't missing many features compared to the Amazon Echo Show, the ones it is missing are relatively important: A small screen means most movie watching will need to occur in your living room, and – while it's great for photos – it just doesn't do justice to most video content.

The most divisive feature,

however, is the lack of a camera. We appreciate Google's concern for our privacy, but not being able to video chat to loved ones is disappointing.

Luckily, this is counterbalanced by features like Home View and Google Photos integration, while the display, though small, is fine for watching when you're rustling up something to eat. The Google Home Hub is also good value, with a functional touchscreen that puts control of your smart home right at your fingertips. ■ APC team

Verdict

The Google Home Hub makes a compelling claim to be the centre of your smart home.





SMART WATCH

#399 | CONSUMER.HUAWEI.COM/AU/

Huawei Watch GT

This smartwatch drops Wear OS for longer battery.

The first two Huawei Watch products were a big part of the initial success of the Android Wear operating system, so it came as a surprise when the company backed away from Google's wearable platform for the Huawei Watch GT. Instead the company decided to use its own software for its latest smartwatch.

The Watch GT has pared back software to increase battery life, and the good news is that this has worked – although at the cost of compromises elsewhere. This is a thin and light smartwatch with a full-colour display, and we found it comfortable to wear throughout our time using it; we also had compliments on how the watch looked on our wrist.

The design is similar to that of the Huawei Watch 2, although it is slimmer. It's 10.6mm thick, and that helps it to sit on your wrist comfortably, without weighing it down like some

smartwatches can. There's a 1.39-inch AMOLED display, which we found to be bright and clear. All of your stats appear clearly on the display, and it's easy to interact with the touchscreen.

There are two buttons on the right-hand side of the watch that enable you to navigate around its interface when you're not using the touchscreen itself. The top button works to wake the watch and then take you back to the main menu, while the lower one is designed for you to set up your own shortcuts. This enables you to easily boot up your favourite apps without having to head into the main menu, which is useful if you're often running with the watch.

There's no support for third-party apps; that could still change, but at the moment what you see on the Watch GT is what you get.

What you do get includes lots of fitness tech, and customisable watch faces

and notifications – but apart from that it's quite limited. For example, there's no Google Pay support here, as there's no NFC chipset or supporting software on the watch.

The Huawei app on your iOS or Android phone connects you to the watch and allows you to choose your specific settings, such as which apps send notifications through to your wrist. We found ourselves setting this up, and then not using the app again much. Battery life is where the Watch GT gets truly exciting though. Huawei believes this watch should be able to last almost a whole month on a single charge, and we found exactly that in our testing, with the GT dropping to 50% after around two weeks of use. We then recharged the watch, and after 10 days of solid use we found it still had 72% left in the tank.

The Watch GT is

designed for those looking for a fitness-focused device that also looks good on the wrist – and if that's all you want you'll likely be a fan of the Watch GT, as it offers an accurate heart rate tracker, fast GPS and a lot of tracking modes in a premium-looking package.

Huawei isn't sure if this will be sold separately in Australia yet, but if you buy a Huawei Mate 20 Pro smartphone from Optus before March 31, or bought one from Vodafone before Feb 4 or JB HiFi before Feb 28, then you get a free Watch GT as long as you claim it by March 24th and it wasn't purchased before January 24. ■ James Peckham

Verdict

Huawei has dropped Wear OS, switching to its own OS – and that's mostly to the detriment of the Watch GT.



software

» APPS FOR ALL YOUR PLATFORMS



Vivaldi

Build your own browser.

FREE | VIVALDI.COM



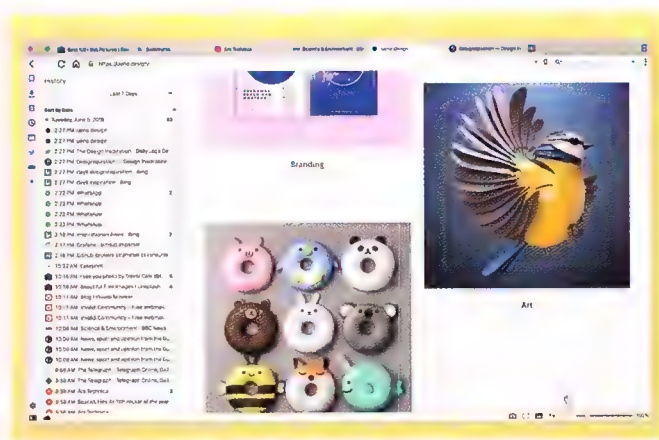
Vivaldi, which is based on the same technology as Google Chrome, is a fully customisable open source browser. It's not as fast as some of its rivals, but its developers are adding innovative new features with every release and everything is fully customizable.

In addition to choosing your own shortcuts, customising the main menu design and specifying the control panel placement, Vivaldi also lets you put browser tabs at the top, bottom, left or right of the screen, or hide them altogether and use shortcuts instead. If you're prone to keeping lots of tabs open, Vivaldi lets you stack and group them to make navigation even easier.

Once that's done, you're ready to start setting up your homepage. This can be any website you like, or you can use a tool called Speed Dial to create a set of tiles for quick access to your favorite sites. It's much like a Favorites menu, but more convenient.

Bookmarks and downloads are accessible via a narrow navigation bar on the left called the Panel, which can be collapsed using a little switch at the bottom. Here you'll also find a notes tool that works much like a text-only version of Evernote, enabling you to jot down thoughts while you browse.

Under Vivaldi's main settings icon which has settings for



keyboard, where you can define your own shortcuts; mouse, for setting gestures; and privacy, including phishing protection. If you're on a slow connection, you can toggle images off using the small picture icon at the bottom left. The double arrow icon beside this offers a range of filters and effects. Some of these (like highlight focus and the CSS debugger) have a clear purpose, whereas others (like the 3D effect that skews the page to create a 'turning' effect) are just for fun.

Finally, visiting vivaldi://extensions to access to the Chrome web store, where you can install any add-on built for Google's web browser. **Cat Ellis**

Emsisoft Emergency Kit

CHECK YOUR COMPUTER FOR MALWARE AND CLEAN IT UP WITHOUT INSTALLING EXTRA TOOLS.

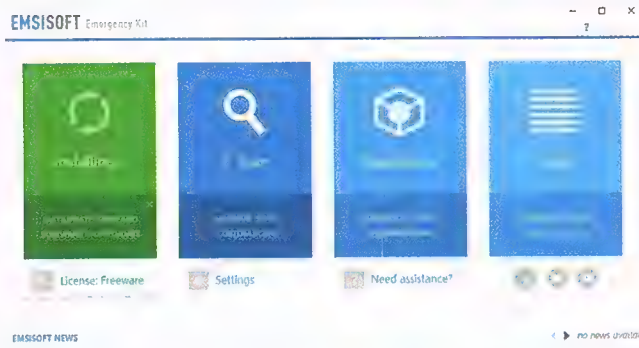
FREE | WWW.EMSISOFT.COM



We all know about the importance of malware protection, but – like backing up data – it's all too easy to keep putting it off until it's too late. If your computer is exhibiting signs of some form of infection, you may well find that it's not possible to install protective software after the fact, or it might be that your protection has been disabled or interfered with.

This is where the appropriately named Emsisoft Emergency Kit can help you out. This malware detection and removal tool picks up the presence of trojans, spyware, adware, worms, dialers, keyloggers and viruses, and can be run straight from a USB drive – perfect if you're unable to download or install software on the affected PC. You can also scan for rootkits, but this means that you have to enable the Direct Disk Access mode which is significantly slower than normal.

The toolkit is compatible with all versions of Windows and it's available in 32- and 64-bit variants. **Mark Wycislik-Wilson** ■





Mac » APPS

CleanMyMac X

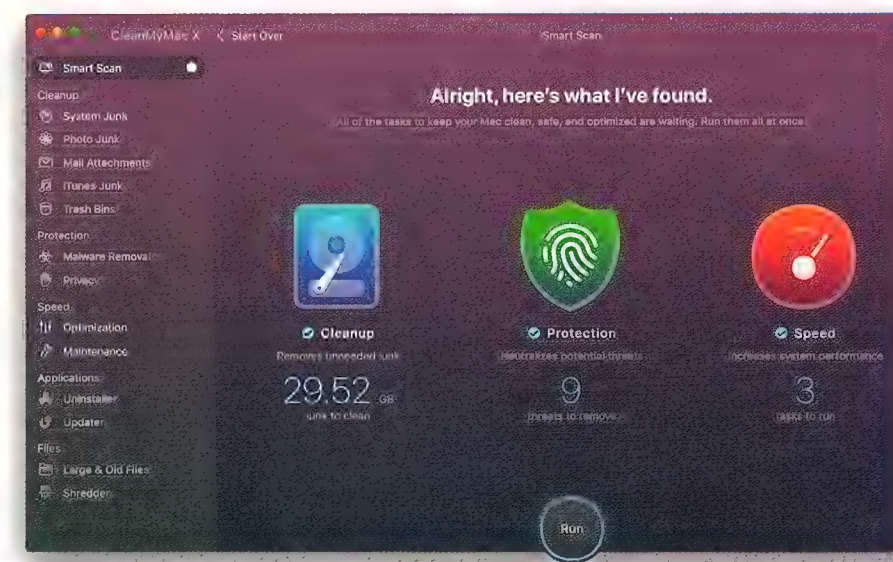
The fast, reliable way to tidy up.

\$128.80, OR SUBSCRIPTION (\$57.20 PER YEAR) | MACPAW, MACPAW.COM

CleanMyMac X is an easy-to-use app that optimises your system. It covers five areas: Cleanup, Protection, Speed, Files and Applications. There are 14 individual modules, or you can click Smart Scan, which is focused on removing junk, neutralising potential threats or increasing your system's performance; a second click runs all three tasks at once.

By default, CleanMyMac purges only common files that the system rebuilds as needed but, if you're using macOS Mojave, you can grant full disk access to root out the junk from built-in apps like Mail, Safari and more. You can preview files before purging them, with granular options to preserve certain cache or log files.

A menu bar app displays key details on system drive storage space, available memory, processor load and network activity. This can be configured to perform tasks like correctly uninstalling apps, warning you when your Mac's available memory



is low, and force quitting unresponsive apps.

CleanMyMac X has proven to be a reliable ally in the war against system

craft or removing old 32-bit apps. Aside from the occasional inaccurate recommendation, the only downside is the price. ■ JR Bookwalter

GoodTask 3

CONTROL YOUR SCHEDULE.

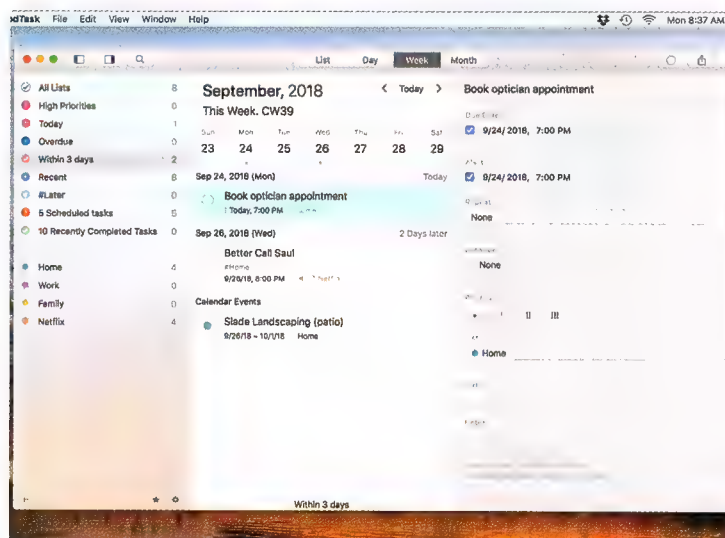
\$9.99 | GOODTASKAPP.COM

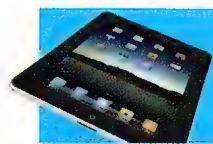
This app combines Apple's Calendar and Reminders and syncs with iCloud. It's more than that, though: it adds several features of its own to do much more than Apple's apps.

With tags assigned, you can view or exclude tasks based on those tags. You can filter notes that include certain text strings; filtering is done using Smart Lists and you can create lists showing overdue items, items in a specific location, or those created recently.

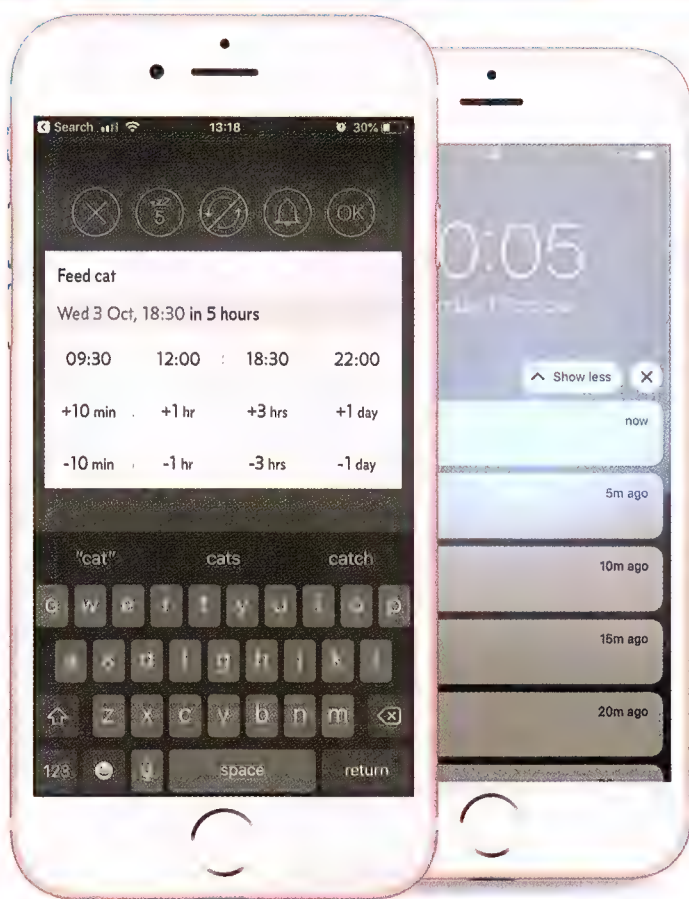
Quick Actions allow you to choose from a number of presets, such as alert times or adding tags. You can edit these or add your own, either when you create a task or by selecting one. You can select multiple tasks and add Quick Actions in bulk. It takes a bit of learning, but becomes a quick way of manipulating tasks – though we'd have liked the option to add keyboard shortcuts.

Annoyingly, GoodTask doesn't access Contacts, but tasks can be input using natural language, and you can create text snippets to make text entry quicker, like using 'nw' for 'next week'. Unfortunately, you can't edit Calendar entries; there's only the option to view them, and snippets are limited to specific actions. ■ Kenny Hemphill





App Store » iOS APPS



Due – Reminders & Timers

An effective way to nag yourself.

US\$4.99, OFFERS IN-APP PURCHASES | DUEAPP.COM

Due reminds you to do things. There are features built in to iOS for the same purpose but, understandably, you may find they don't quite hit the mark. Timers (in Clock) notoriously allows only one item at once. Reminders, which works across iOS and macOS, isn't the most intuitive app to use, and when a reminder occurs it just pops up a notification that is all too easy to dismiss when busy.

Due makes it easy to set a reminder and hard to ignore it. The main All Reminders screen starts up with a couple of useful examples to show you how to flick an item leftwards to mark it done, or swipe it firmly off the side of the screen to delete it entirely. In Settings, from the menu at the top left, you can adjust these gestures.

Add your own items and they'll get listed under subheadings: Overdue, Today, and Next 7 Days. It's the way you set them up that distinguishes Due from other to-do apps. Although you can tap the date to use the standard iOS rolling date picker, the default input method is Quick Access Times. This is a matrix of preset times and options to add or subtract minutes or days. At first it's infuriatingly limiting, but when you realise you can customise everything in Settings, it makes sense as a shortcut.

QUICK TIME

New to Due 3 (a US\$2.99 upgrade if you're a previous user) is the ability to use Quick Access Times from notifications, activated by turning on Settings > Notification Snooze > Custom Snooze. So when you receive a reminder, you can swipe left, tap View, then quickly tell Due when to remind you again. If you don't, it'll Auto Snooze for five minutes and then keep reminding you again until you mark the item completed. Simple but effective.

Unfortunately, Due suffers a little from not being a built-in iOS feature. New items sync between devices (Watch is supported, and there's a Mac version at US\$9.99), but when you don't have the app open, this relies on Background App Refresh and it doesn't always work instantly. You can import items from Reminders, but using both gets messy, and only Reminders supports geolocation, sharing, and creating items using Siri.

The app's Timers page supports multiple timers and saves them for reuse. You don't get the same snooze flexibility with timers, though. Ultimately, we can't help feeling reminders, timers, alarms and calendar events should all work together. For the time being, Due is a simple way to remember everyday tasks that gets easier the more you sink your teeth into it.. ■ Adam Banks



Google Play » ANDROID

Snewpit

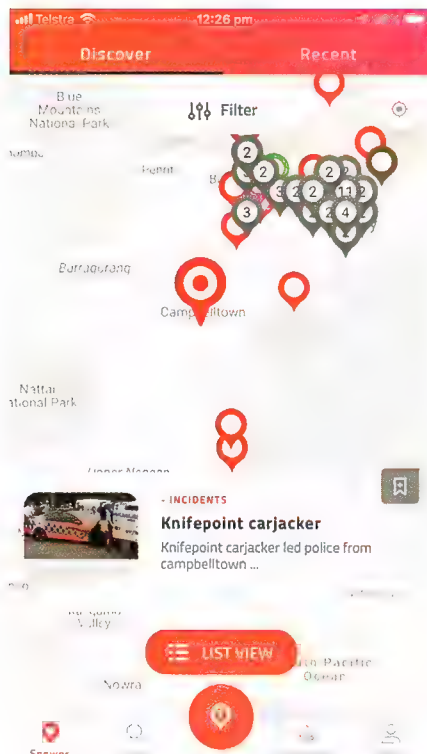
Like 'snoop it'

FREE | [HTTPS://SNEWPIT.IO/](https://snewpit.io/)



First, the elephant in the room – yes, 'snewpit' is an awful name, and if you're trying to tell people about this app you'll definitely have to clarify that it's not spelled 'snoopit'. I suppose they wanted the word 'new' in there. Once you're past that, though, Snewpit is an interesting, although potentially problematic, app. The idea is that users can submit local news stories, along with photos, videos, and short blurbs, to keep each other informed. There are obvious advantages here, especially if your local news isn't as on the ball as it could be – being able to find out why that road is closed off, or share the details of a missing person easily, has obvious advantages. But these bite-sized pieces of user-submitted news, and the idea of peer-to-peer news in general, feels like another way of asking the general public to perform unregulated labour that is generally best left to paid professionals. It's an interesting app, as long as you don't rely on it for all your news going forward.

■ James O'Connor



Welcome to Marwen AR

Augmented advertising.

FREE | WWW.WELCOMETOMARWEN.COM/

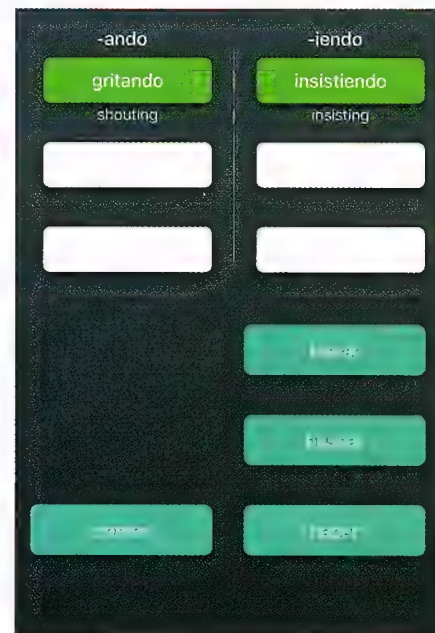


Welcome to Marwen's new app is calling itself the 'world's first augmented reality film clip', which is significant in its own way, even if it's only really a marketing milestone. *Welcome to Marwen* – in cinemas in Australia from January 31 – is about Mark Hogancamp (played by Steve Carell), who constructs a World War II diorama and populates it with dolls of himself and the women in his life after a savage beating outside a bar leaves him with no memory of his past life. It's based on the real events portrayed in the movie *Marwencol*, and if this app is anything to go by, it's not going to be very good. The AR functionality is neat, as you can move around a recreation of Hogancamp's diorama as a scene from the movie plays out, take photos, and click on characters to learn more about them and watch behind-the-scenes footage. But the scene itself is confounding, and while it's a neat tech demo it's still, effectively, just an ad for a movie that doesn't look so hot.



■ James O'Connor

? Let's see if you know when to use -ando and when to use -iendo



Learn Spanish with Lirica

Get Duolingo off your back.

FREE | N/A



Lirica (Spanish for lyrics) is an app that promises to help you learn Spanish through song lyrics. This promise is somewhat contingent on you already being a fan of Spanish pop music, I'd say – there's an assumption here that Enrique Iglesias, Elvis Crespo and Marc Anthony are all your jam, and that you'd like to understand the lyrics to their songs. The lessons take words from different verses in the songs and give you some context behind their meaning and the grammatical principles that dictate their usage, which should help you to better grasp what the songs are about. I'm not convinced that this app is actually going to be particularly helpful with education, though – teaching random words without first establishing the language's building blocks seems misguided unless you're starting with a solid knowledge of Spanish, and some of the tasks don't feel helpful. Plus, the premium service costs up to \$15 per month, and a current deal on 6-month plans indicates that they're struggling with subscriber numbers. It's neat, but not a comprehensive solution.

■ James O'Connor



GhostBSD 18.10

The prospect of experiencing BSD from within a familiar environment is too hard to resist for Mayank Sharma. Altogether now: who you gonna call?

FREE | WWW.GHOSTBSD.ORG

Linux isn't the only open source operating system out there. While they haven't caught the fancy of the mainstream press, BSDs are popular with experienced users and administrators for their robustness, reliability and security.

Although you can transform a BSD installation into a desktop, it'll require some work. This is where GhostBSD shines. It offers a default out-of-the-box experience that's virtually identical to Linux. On the face of it you wouldn't know you're running a BSD since the GhostBSD Live environment boots into the Mate desktop whose menus house all the familiar tools you'll find on just about every desktop Linux distro such as Firefox, Thunderbird, Shotwell, LibreOffice and such.

The latest release, GhostBSD 18.10 isn't any different from the previous releases in terms of the desktop. Behind the scenes however, the project has shifted allegiances. Instead of being based on pure FreeBSD, GhostBSD is now built from a FreeBSD-based OS called TrueOS. As a result, FreeBSD ports and packages are now incompatible with GhostBSD whose packages are built from the TrueOS ports collection. Furthermore, GhostBSD now inherits TrueOS goodies like the OpenRC init system and the LibreSSL stack. Another major change is the overhaul of the Live system, which has been rewritten to fix many issues. The live system is now a uzip compressed file that's uncompressed inside a chroot environment during boot. The developers have also removed the UnionFS file system because of several problems, which has restricted the dexterity of the live system.

HAUNTED INTRODUCTION

You get the first sign that you're running a non-Linux OS while anchoring GhostBSD on to the hard disk. The OS relies on its own multilingual graphical installer called GBI that uses the pc-sysinstall back-



end also developed by TrueOS. The installer offers an automated partitioning scheme if you wish GhostBSD to take over the entire disk and eases the process of getting the OS onto the hard drive. For familiarity on the CLI, you can choose to use the Bash shell instead of the default fish shell.

Instead of the GRUB bootloader, the OS uses the FreeBSD hybrid loader. The other big difference is the default filesystem. Instead of the familiar Ext4, GhostBSD offers a choice between two BSD filesystems UFS and ZFS. GhostBSD defaults to the developer's favourite ZFS. Once installed, the OS looks spiffy and is responsive on both older and newer hardware. For package management GhostBSD relies on the OctoPkg front-end to the pkgng package management system. You shouldn't have any issues navigating the package manager as it's fairly intuitive. You can also use FreeBSD's well-documented CLI package manager pkg, which can be a good starting point on the journey to get familiar with BSD.

It's also easy to update both the

system as well as installed programs using Update Station, GhostBSD's custom update utility. It's the project's utilities that set it apart from other desktop-oriented BSDs. Besides Update Station, there's NetworkMgr that now supports multiple wired and WiFi card connection and StationTweak, which is a fork of the Mate Tweak app to customise the desktop. You can use StationTweak to toggle Compositing effects and control various elements of the UI.

One of the most interesting ones is the choice of the various panel layouts. In an interview with FreeBSD Bytes, GhostBSD's lead developer has said that the next goal of the team is to fix or replace more components from the Mate desktop that don't perform as per their expectations. In 2019, the project will also be pushing updates to the base system packages and work to improve the usability and functionality of the desktop. ■



PART 01

LOCK DOWN YOUR PC NOW

Worried about your online and offline security and privacy? Nick Peers reveals the tips and techniques you need to lock down your computer

PART 02

WINDOWS SECURITY SUITES

Nick Ross examines the best security and AV apps to keep your PC safe.



WORRIED ABOUT YOUR ONLINE AND
OFFLINE SECURITY AND PRIVACY?
NICK PEERS REVEALS THE TIPS AND
TECHNIQUES YOU NEED TO LOCK DOWN
YOUR COMPUTER.

There's hardly a day goes by without some new hacking controversy. From online sites getting compromised to people facing down ransomware demands, the always-connected era is one fraught with danger. Prevention is always better than cure, so what can you do to ensure you're as protected as you can be?

In this feature we're going to arm you with all the tools, tips and guides you need to close the door on drive-by hackers, malware and other online threats to your privacy and security. We'll start by locking down your PC – ensuring your security software is up to scratch, you have a firewall that's fit for purpose and that your personal data is encrypted and as difficult to steal as possible.

Next, we'll look at tightening the security of your home network – you'll discover how to log on to your router, improve the security of your Wi-Fi network

and restrict access to only those devices you explicitly choose. We'll also show you how to perform a quick security sweep of your wireless tech and check it for weak spots.

Then it's on to your Internet connection – you'll learn how to encrypt your connection using a VPN, even when browsing in public spots, and discover how to engage in secure web browsing, email and even chat. Last, but not least, you'll learn how to implement a foolproof – and watertight – password management system to ensure you have unique, strong passwords without making things awkward. We'll even show you how to switch on two-factor authentication for even greater protection.

Follow these tips and you'll lock out the snoopers and hackers, and keep your personal data as private and protected as it can be. It's time to fight back.

Tighten up your security

Step one in protecting your home starts with your own PC.

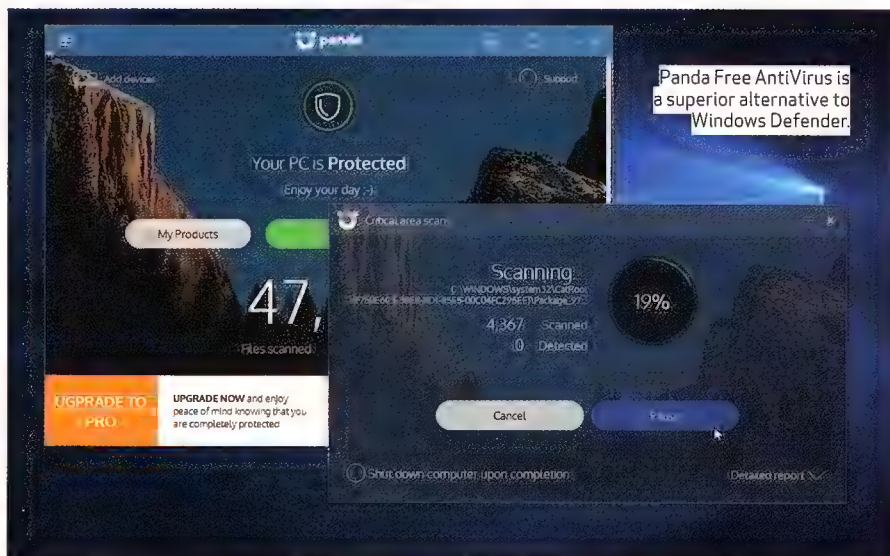
Let's begin by tightening the security of the computers in your home. First, take a look at your security software. If you're currently using Windows Defender, we recommend that you switch to something stronger. If you're happy to rely on free protection, then Panda Free AntiVirus (www.pandasecurity.com) is an excellent choice. It's light on its feet, easy to use and gives you protection that matches many commercial products. It includes built-in protection against Potentially Unwanted Programs (PUPs) and an optional browser plug-in, which offers safe web searches and protection against dodgy websites. Panda is also less intrusive when it comes to pop-up upgrade offers – you can switch off these completely by opening its Settings.

Paid-for protection from the likes of Kaspersky and Norton goes even further, and you can get discounts by buying multi-computer licences to cover your whole household. If going down this route, keep an eye out for frequent 50 percent off deals – you can purchase these any time of the year, then apply them once your subscription has run out.

SECURE YOUR FIREWALL

If you decide to use free protection, you'll be relying on the Windows Firewall. It has all the tools you need to close the door to hackers, but it doesn't use them fully. Windows Firewall monitors incoming traffic from your network and the Internet for potential threats, but waves through all outgoing traffic from applications without a second thought.

If you don't have a third-party firewall installed, then TinyWall (<https://tinywall.pados.hu>) gives you a way to use Windows Firewall as a two-way firewall. True, it needs a bit of configuration to get working, but our step-by-step guide on the page opposite reveals all. The only caveat is that it can take some time before all your software is working correctly – look out for failed updates and applications complaining about not having enough access. If you recognise and trust the app in question, simply follow the guide to add it to TinyWall's whitelist. Also note the potential issues with sharing files and printers with others



"The answer is to encrypt your files, and that can be done in a number of ways."

– you can work around most of them, but if it's too much hassle, look for a paid-for solution instead.

ADD MORE PROTECTION

Whatever security software you have installed, there's always room for extra help. You can start by installing Malwarebytes Anti-Malware Free (www.malwarebytes.org), which can root out and remove infections missed by your main security software. The free version should be used to scan your system at least once a week, or pay for the Premium version for real-time protection (without conflicting with your other security tools).

If your security software doesn't offer any protection against ransomware – the free version of Panda doesn't, for instance – then install BitDefender Anti-Ransomware Tool (www.bitdefender.com/solutions/anti-ransomware-tool.html) to block four known ransomware families. Ransomware is particularly nasty malware that encrypts all the data on your hard drive, demanding you pay a hefty ransom in return for the key required to unlock it. Another way to protect yourself is to regularly back up your data both offsite (the cloud) and onsite (an external hard drive).

PROTECT YOUR DATA

Personal files are priceless, but they're also sensitive. If you're a laptop user who takes their PC on the road, you should ask yourself how you would feel if your laptop was stolen. The answer is to encrypt your files, and that can be done a number of ways depending on where the data is stored.

If you're carrying files on a USB flash drive, the easiest way is to create an encrypted 'container' into which you place your most sensitive files. The container is password-protected – supplying the correct password unlocks the files within as a virtual disk drive, but otherwise they remain hidden as well as scrambled. If this approach appeals, take a look at Rohos Mini Drive (www.rohos.com/products/rohos-mini-drive/). This lets you to create virtual drives up to 8GB in size for free.

If you want to encrypt your entire machine, then Windows 10 Professional users should type bitlocker into the Search box to find out how to use Windows' own encryption tool. If you're running Windows 10 Home, then use VeraCrypt (<https://veracrypt.codeplex.com/>). You can use it either to create encrypted volumes of locally stored data or encrypt entire drives and partitions – see the 'System Encryption' section of VeraCrypt's documentation.

SECURE YOUR FIREWALL WITH THIS FREE APP.

• **loss** of *apertus* would have broken the connection

- ✓ Checking the connection
- ✓ Checking firewall and antivirus configurations
- ✓ Running Windows Network Diagnostics

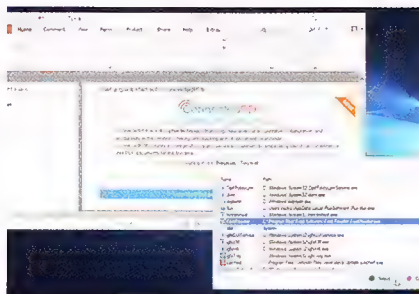
Check your Internet connection

Check any cables and reboot any router network devices you may be using.

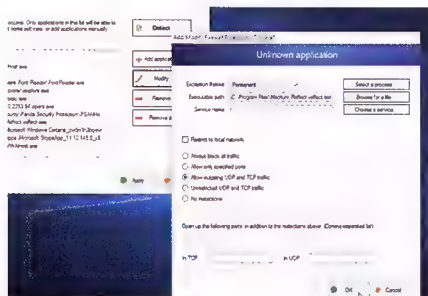
Allow Opera to access the network in settings

If it is already listed as a program allowing incoming traffic from the Internet, and adding it as a program that can access the Internet:

- Change mode
- Manage
- Show connections
- Disable
- Unblock wide traffic
- Enable blocklists

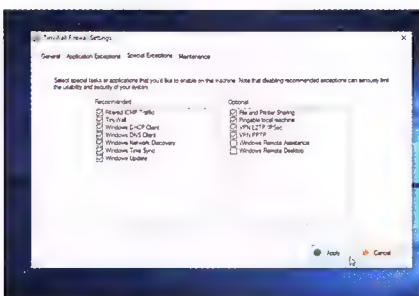


1 After installation, TinyWall will block most applications from accessing the network by default – including your favourite web browser. Open your browser, then click 'N' on the Taskbar notification area, right-click the new TinyWall icon and choose 'Whitelist by window'. Click inside the browser window, and it should now work correctly.

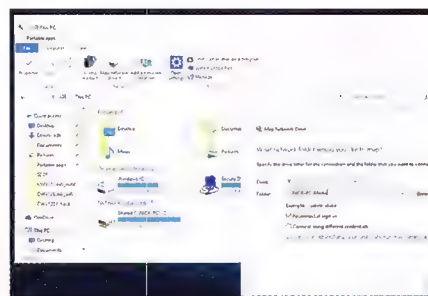


4 Right-click the TinyWall icon and then choose the **Manage > Application Exceptions** tab to view a list of whitelisted programs – if you’ve been using learning mode, you should hopefully see your target app’s programs and processes appear here. You can use this option to remove unwanted apps or select and choose **Edit** to fine-tune its access levels.

4 You can repeat this process for all your other open applications, or you can choose 'Whitelist by executable' to manually locate a program executable. If the app is running, try 'Whitelist by process' to select it from a list of running programs. To whitelist it, simply highlight the program's process name and then click Select to do so.



5 Some applications use multiple processes, which can be tricky to identify. To resolve this, close all programs, ensure your PC is malware free, then right-click the TinyWall icon and choose 'Change mode' > Autolearn. Now launch your program and use your PC for a few minutes before switching back to Normal mode. TinyWall will now whitelist the app.



- 4** Right-click the TinyWall icon and then choose the Manage > Application Exceptions tab to view a list of whitelisted programs – if you’ve been using learning mode, you should hopefully see your target app’s programs and processes appear here. You can use this option to remove unwanted apps or select and choose Edit to fine-tune its access levels.
- 5** If you want to allow file and print sharing traffic on your network, switch to TinyWall’s Manage > Special Exceptions tab and tick the relevant box. Click ‘Apply’. Windows will still complain Print and File Sharing is disabled, but it won’t be true. You will, however, need to whitelist any printer management software and connect slightly differently.

6 Open File Explorer and type \\<server>\ into the Address bar, replacing <server> with the computer name of the PC you wish to connect to. You should see a list of its shares appear, enabling you to browse and connect to them. Select 'This PC' and click 'Map network drive' to create permanent links to these shared files and folders.

IF YOU BACK UP DATA TO THE CLOUD, YOU MAY BE CONCERNED ABOUT ITS SECURITY.

If this is a concern, you can encrypt your data locally before uploading it to the cloud – if you're already using VeraCrypt, for example, you could simply create an encrypted volume inside your cloud folder and store all sensitive data in there. On the other hand, if you primarily use your cloud provider for syncing data between your various devices, you'll need to choose a

There are a number of options out there, but one that's unlimited and free for personal use is nCrypted Cloud (www.encryptedcloud.com/apps/windows/). Once installed, set up your free nCrypted Cloud account, then connect cloud providers (Dropbox, OneDrive, Box and Google Drive are all supported) and finally choose the folders that you want to encrypt. If you want access from other computers or mobile devices (Mac, iOS and Android are also supported) then simply install the relevant app or program, link it to your nCrypted Cloud account and you're done.



Guest Network

You can configure the wireless network for guests.

Guest Network: ☒ Enable 2.4G Guest Network
☐ Enable 5G Guest Network
☐ Disable Guest Network

SSID:

Security:

Authentication Type:

Encryption:

Wireless Password:
 (Enter ASCII characters between 8 and 63 or Hexadecimal characters between 8 and 64.)

Group Key Update Period: (seconds, minimum is 30, 0 means no update)

Advanced

Save

Move your visitors on to a guest network after tightening your Wi-Fi network's security.

Lock down your network

Stop hackers and snoopers from accessing your router

Even if you've yet to embrace the concept of the smart home, the chances are you will still have a number of devices, as well as your PC, competing for bandwidth on your home network. Read on to discover how to reduce its vulnerability with a home network security audit.

LOCK YOUR ROUTER

Let's start with the gateway between your home and the Internet. If you have never carried out admin on your router before, then you will definitely find ways in which to strengthen its security. You can usually manage your router through your web browser by entering its four-digit IP address into the Address Bar. To do that, first open Settings > Network and Internet, and click 'View your network properties', then make a note of your router's IP address under Default Gateway.

Type the IP address into your browser, and you will now see a status or login page. Each router handles things differently, but they all follow a broadly similar pattern. Consult its documentation, look on the router box or visit its support website for the default login details to gain access.

It's possible for drive-by hackers to target routers remotely, relying on users having left the default password in place, so if that's the case on your router, you should look for the option to change this – on our TP-Link router it's under System Tools > Manage Control, but other routers will vary.

PROTECT YOUR WI-FI

Once the router password has been changed, it's time to tighten up your Wi-Fi network. Your router should have already set encryption (WPA2-PSK with AES encryption ideally), but it's a good idea to change the default password. Yes, you'll have to reconnect all your wireless devices, but you'll immediately kick off any unauthorised devices who might have been using it without your knowledge. If you have separate 2.4GHz and 5GHz networks set up, repeat for both (and consider setting unique passwords for each separate network).

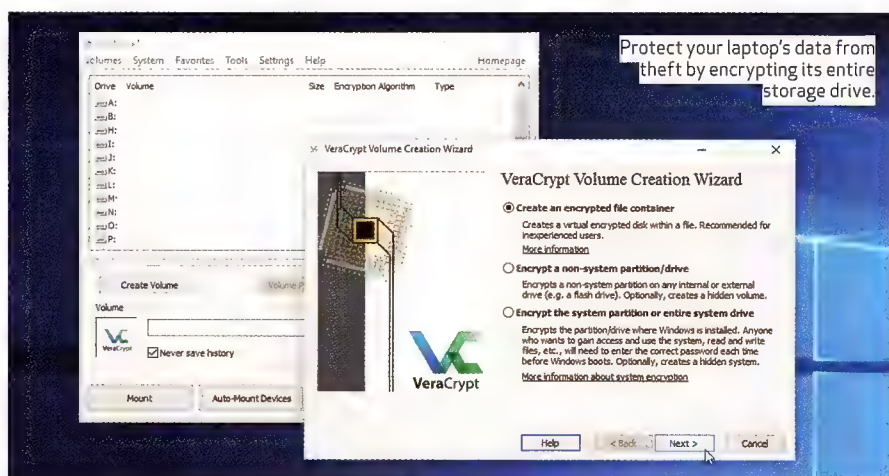
Each computer or device on your network is identified using its MAC address, a six-digit hexadecimal code. If your router supports MAC filtering, it means you can lock down your wireless network even further, by only accepting connections from devices with specific

MAC addresses.

First, you need to identify the MAC address for each device you own, which we recommend you write down and record somewhere secure. You'll need to look up instructions for your specific device, but it'll typically be under Settings somewhere. In the case of your wirelessly connected PC, look under Settings > Network and Internet > 'View your network properties' in the Physical Address (MAC) section.

Once you've got all the MAC addresses you need – including, critically, your wireless PC if applicable – enable MAC address filtering and enter the addresses one by one. If prompted, choose the option to only allow those devices with MAC addresses that match.

If you frequently allow family and friends to access your Wi-Fi network when they're around, enabling MAC



address filtering may be a step too far. That said, explore your Wi-Fi router's settings to see if it offers a guest network function – if it does, you can give visitors Internet access without opening up the rest of your network to them. Make sure that you enable the WPA/WPA2 encryption option for the guest network, and set a unique wireless password for your guests to use.

MORE SECURITY SETTINGS

Your devices connect to the Internet using a series of virtual ports, with different ports used by different applications and services. Some are standardised – for example, port 80 provides connections to the web, while port 25 is used by SMTP email servers, but others are allocated on an application-by-application basis (if you want to access your Plex Media Server over the Internet, for example, you need to connect through port 32,400).

In the past, you had to manually open up ports through your router's setup utility, but thanks to the arrival of Universal Plug and Play (UPnP) apps can now communicate effortlessly with your router and open the ports they need in the background. While this is convenient, it does open your router up to potential breaches (malware can open up ports to wreak havoc, for example). You should, at the very least, check periodically to see which apps have access to your router and if you don't recognise any, disable it immediately to close all ports. You can then investigate the dubious app further using the IP address to target the device it's originating from before deciding whether or not you should re-enable it.

A better approach – if less convenient – is to manually set up port forwarding yourself. Apps should alert you when this needs to be done, and you can follow the step-by-step guide at the bottom of this page to see what information needs to be set up for each port.

One final thing: check your router's support website to see if any firmware updates are available for it. These can add more features, but may also contain security fixes. Installing an update usually involves downloading the update file to your PC, then uploading it manually to your router's configuration utility where it's then applied. Be sure to back up or record your settings before doing so, in case the update wipes them out.

Protect home network kit

YOU'VE TIGHTENED YOUR ROUTER SETTINGS, BUT WHAT ABOUT THE DEVICES CONNECTED TO YOUR NETWORK?

The growth in smart home tech means many more wireless devices are now communicating over the Internet, so make sure these are locked down too. We'll show you how to use strong passwords and other measures to lock down any account settings screens, but you should look out for firmware updates that can help close security loopholes.

If you have a webcam attached to your PC make sure it's not in a place where it could be used to spy on you. Keep an eye on the activity light – it should only be on when you're using it. If the camera is a USB model, consider unplugging it when not in use or at least cover the lens, so even if it is compromised it won't see anything. If you use a security camera, protect it with a strong password and limit who has access. You should also switch on its notifications to make sure you're alerted whenever it's used.

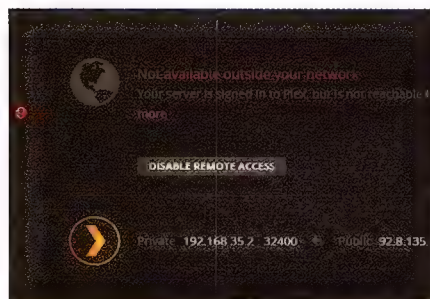
If you'd like to see what's currently connected to your home network – potentially enabling you to spot snoopers or hackers – then download and run Advanced IP Scanner

(www.advanced-ip-scanner.com). It will list all currently active network devices. Use the Manufacturer field to help identify unknown devices if the name doesn't give you any clues, and keep scanning from time to time.

IP	Name	Manufacturer
192.168.1.1	Qnap TS-219PUC	Qnap Systems, Inc.
192.168.1.2	ASUS	ASUS
192.168.1.3	TP-LINK TL-WR841N	TP-LINK
192.168.1.4	TP-LINK TL-WR841N	TP-LINK
192.168.1.5	TP-LINK TL-WR841N	TP-LINK
192.168.1.6	TP-LINK TL-WR841N	TP-LINK
192.168.1.7	TP-LINK TL-WR841N	TP-LINK
192.168.1.8	TP-LINK TL-WR841N	TP-LINK
192.168.1.9	TP-LINK TL-WR841N	TP-LINK
192.168.1.10	TP-LINK TL-WR841N	TP-LINK
192.168.1.11	TP-LINK TL-WR841N	TP-LINK
192.168.1.12	TP-LINK TL-WR841N	TP-LINK
192.168.1.13	TP-LINK TL-WR841N	TP-LINK
192.168.1.14	TP-LINK TL-WR841N	TP-LINK
192.168.1.15	TP-LINK TL-WR841N	TP-LINK
192.168.1.16	TP-LINK TL-WR841N	TP-LINK
192.168.1.17	TP-LINK TL-WR841N	TP-LINK
192.168.1.18	TP-LINK TL-WR841N	TP-LINK
192.168.1.19	TP-LINK TL-WR841N	TP-LINK
192.168.1.20	TP-LINK TL-WR841N	TP-LINK
192.168.1.21	TP-LINK TL-WR841N	TP-LINK
192.168.1.22	TP-LINK TL-WR841N	TP-LINK
192.168.1.23	TP-LINK TL-WR841N	TP-LINK
192.168.1.24	TP-LINK TL-WR841N	TP-LINK
192.168.1.25	TP-LINK TL-WR841N	TP-LINK
192.168.1.26	TP-LINK TL-WR841N	TP-LINK
192.168.1.27	TP-LINK TL-WR841N	TP-LINK
192.168.1.28	TP-LINK TL-WR841N	TP-LINK
192.168.1.29	TP-LINK TL-WR841N	TP-LINK
192.168.1.30	TP-LINK TL-WR841N	TP-LINK

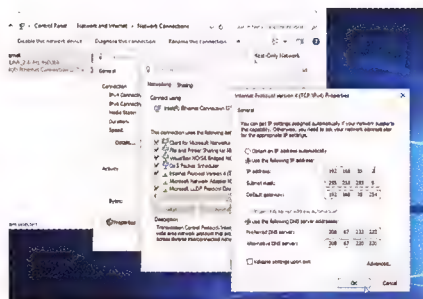
Open up ports manually

FOR APPS WITH SPECIAL NEEDS.



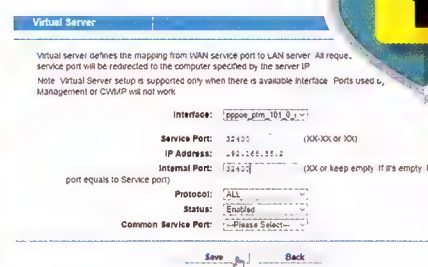
1 CHECK OUT AN APP'S INTERNET NEEDS

Any app on your computer (or other device) that needs access to the Internet should make it clear what you need to do in order to open up access to it. You should start by looking into the program's own settings to find out where you determine which ports it requires and the steps you need to follow to make it work.



2 SET STATIC IP ADDRESS

If you've not already done so, you'll need to set up a static IP address for the device that is running the application. In Windows 10, you should follow the guide at <https://portforward.com/networking/static-ip-windows-10.htm>. Make sure that you give the device an IP address which doesn't clash with your router's DHCP server.



3 ADD NEW PORT

Armed with the instructions provided in the guide detailed in Step 2, locate the port forwarding section of your router's configuration utility. Now create a new port, entering the port number into both port fields and your device's IP address into the IP Address field. Click Save or Enable to test the connection and see if it's working correctly.



Protect yourself online

Boost privacy and security when using the internet.

Now let's make your Internet connection more secure. Let's start with your DNS server. This is used to translate web addresses into their actual physical IP addresses. Normally, your DNS server is provided by your ISP, but it's not the best choice for performance and security reasons. Alternatives such as OpenDNS are faster, more reliable and, crucially, apply more security checks to validate web addresses. With OpenDNS, you can even sign up at its website (www.opendns.com) for things like parental controls and identity theft protection.

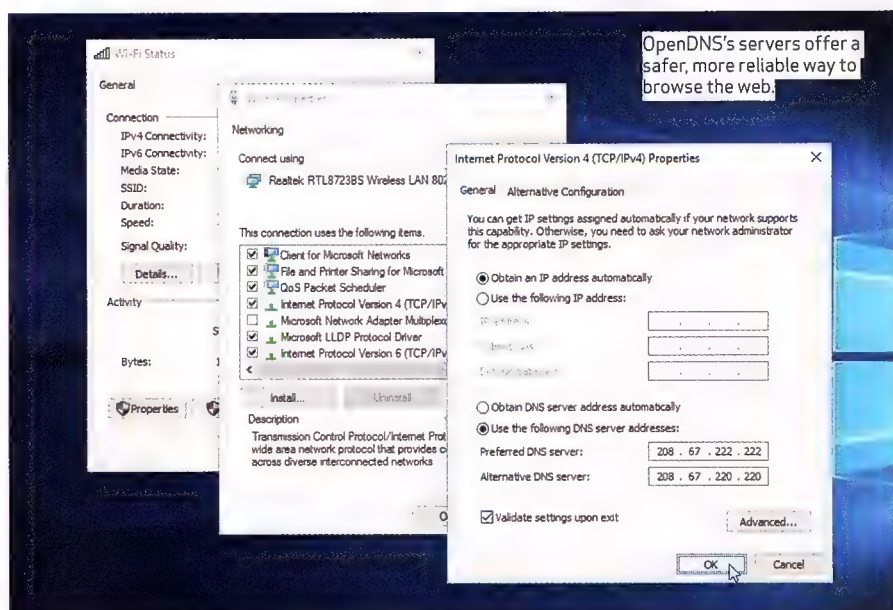
Alternatively, log in to your router, locate where its DNS settings are stored, and then change them to the following addresses: 208.67.222.222 and 208.67.220.220. The effect will be immediate. If you lose your connection, check that you've added them correctly.

If you have any devices you use away from home, you can change their DNS settings to OpenDNS – in the case of a Windows 10 PC, you need to type network into the Search box and click 'View network connections'. Double-click your adapter's entry and click Properties, then select 'Internet Protocol Version 4 (TCP/IPv4)' and click Properties. Select 'Use the following DNS server addresses' and enter 208.67.222.222 and 208.67.220.220 into the two boxes, then click OK.

SECURE WIRELESS CONNECTIONS

When you're on the go, it's tempting to connect to any public wireless hotspot, even ones that don't ask you for a password. The problem is, these are often completely open, allowing anyone to eavesdrop on you. That's where a VPN or Virtual Private Network comes in.

A VPN creates a 'tunnel' through a public network, that enables you to connect to the Internet, with all the traffic to and from your device encrypted. If you just want to browse the web, then install the Opera web browser (www.opera.com), which includes its own VPN. Look for the VPN button in your Address Bar (you can enable it via



Menu > Settings > 'Privacy & security'). Click it, flick the switch to On to encrypt your web browsing. If you want to widen VPN support to all your network traffic, the simplest solution is to install CyberGhost VPN (www.cyberghostvpn.com), which can encrypt your entire connection. The free version is unlimited, but slow – pay the US\$3.50 monthly fee for faster performance.

MORE SECURE WEB BROWSING

Your Internet connection may now be secure, but you can still do more. Opera comes with its own built-in adblocker, which can help you avoid adverts as well as malware, but if you are using another browser, install the Adblock Plus plug-in instead.

It's also a good idea to connect securely to websites when you can, using the 'https://' protocol rather than the insecure 'http://' one. Remembering this is tricky, so install the open-source Smart HTTPS add-on, and it will try to connect securely.

Half of the trick of staying safe online lies in avoiding dodgy websites. While web browsers are smarter at detecting and diverting you from sites that are known to be dangerous, there's always room for improvement. See what web-filtering tools your security software offers in the form of a



You can use an app such as Mailwasher to check your emails before you download them to your PC.

browser toolbar and use it to search the web instead of Google.

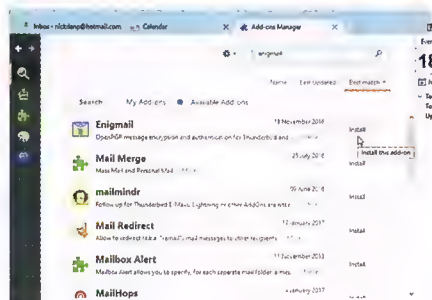
Similarly, be careful with software downloads – get them from a reputable website and scan the file with your anti-malware tool before running it. Exercise similar caution with browser add-ons – review each one before you install it, and periodically check which add-ons have been installed, removing any you no longer need or recognise.

It's a similar story with email. Avoid clicking any links and instead type the URL into your web browser directly to ensure you end up going where you think you should. You should also scan email attachments before opening them, and employ the services of tools such as Mailwasher (www.mailwasher.net) or PopTray (www.poptray.org) to screen messages before they land.

Emailing someone is akin to sending a postcard – anyone can read it. If you use Thunderbird, check out the step-by-step guide to find out how to encrypt email.

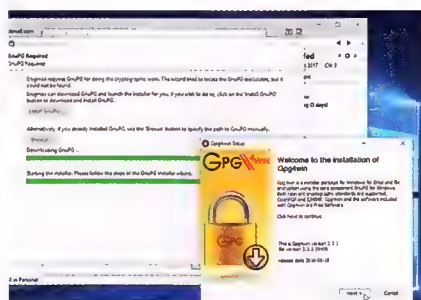
Send emails securely

WITH THUNDERBIRD AND GPG.



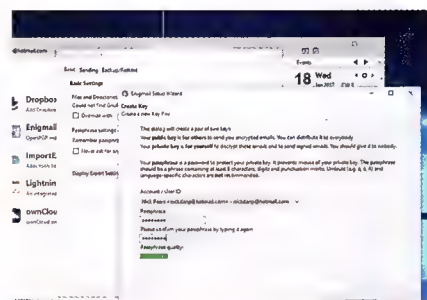
1 SET UP ENIGMAIL

First, you need to install the Enigmail plug-in for Thunderbird. To do that, open the Thunderbird menu and select 'Add-ons', then click the 'Get Add-ons' button. Type Enigmail into the search box, then click Install next to Enigmail. When it's downloaded, click Restart Now to restart Thunderbird.



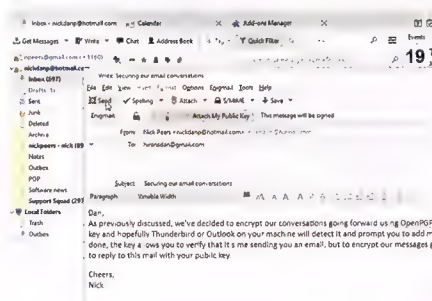
2 ADD GPG

After installing the Enigmail plug-in, go to Extensions > Options > Enigmail. You'll now be told you need GnuPG – click the Setup Wizard and follow the prompts, choosing 'Install GnuPG...' when prompted to download and install the required components (be sure to tick Kleopatra, which is on the list).



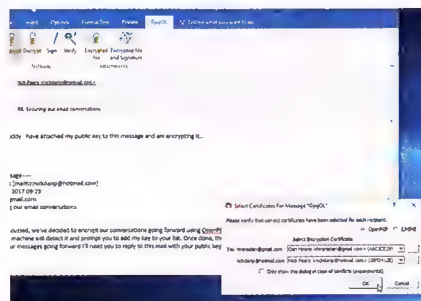
3 CREATE CERTIFICATE

You will now be prompted to create a new key pair for each email account that you have. Enter a passphrase to protect your private key (see over the page for tips on how to create a secure password), then generate it and create a revocation certificate when prompted. Just in case you ever need to.



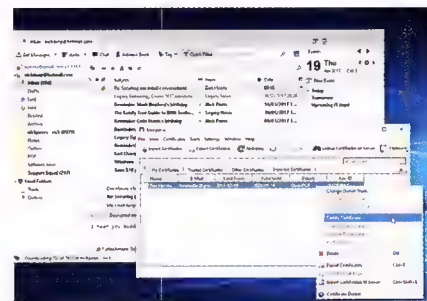
4 SHARE CERTIFICATE

Open a new message and you'll see Enigmail is warning you the email is unsigned and unencrypted. Choose Enigmail > Sign Message, then click Attach My Public Key. Include a suitably descriptive message and click Send, entering your passphrase when prompted. The message will be sent.



5 RETURN THE FAVOUR

If your recipient has configured GPG on their email client (Gpg4win – www.gpg4win.org – also supports Outlook, for example), then they should receive notification of your public key. They will now be able to mark this as trusted, then they can reply to your message using a public key of their own.



6 SECURE THE LINE

When you receive their reply, save the .asc file to Downloads, then open Kleopatra and import the certificate. Once imported, right-click it and choose Certify Certificate if you trust its origin. Future conversations between you and your contact can be encrypted by going to Enigmail > Encrypt Message.

Chat securely

DO YOU OFTEN STAY IN TOUCH THROUGH INSTANT MESSAGING APPS SUCH AS SKYPE?

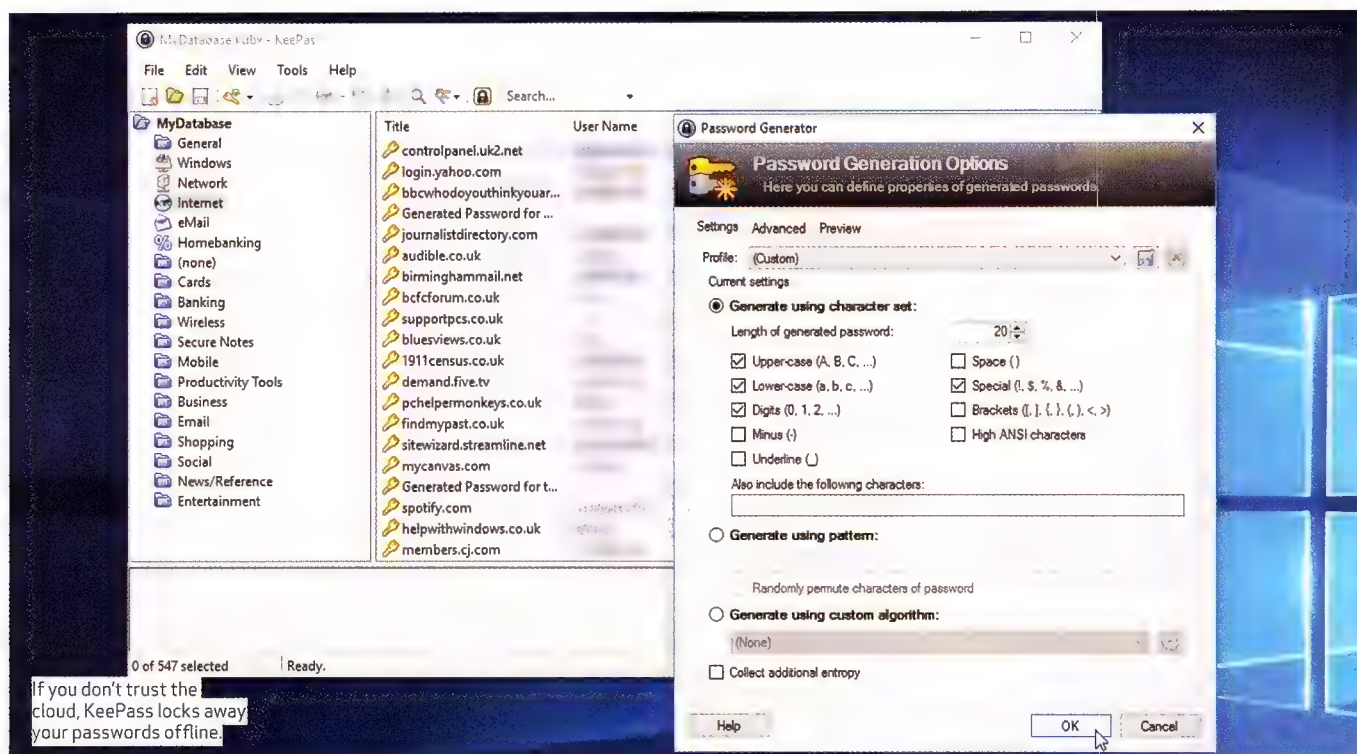
While they can be great fun, the bad news is that Skype, in particular, isn't that secure. If you want true end-to-end encryption for voice, video and text-based chats (as well as secure file sharing), then you'll need to look into using an alternative solution.

The most secure we have found is Retroshare (www.retroshare.net). The only catch is that you'll have to convince all your contacts to use it too – if this is a deal breaker, take a look at Jitsi (<https://jitsi.org/>), which supports a number of different messaging platforms.

You can install Retroshare (choose the QT5 version when at the download page) to your PC's main storage drive or run it as a portable application, then set up your account and

get each contact to do the same. You then export certificate files to send to each contact before importing their file in turn. Tick 'Authenticate friend (Sign PGP Key)' if you're confident in their identity, then wait while Retroshare's Connection Assistant sets up the connection.

It's a fiddly process getting that initial connection set up (and you have to repeat it for each device you install Retroshare on and import your identity into), but once both of you are verified and connected to the other, you can be secure in the knowledge that future chats aren't just encrypted and secure from unwanted eavesdroppers, but that you know exactly who you're chatting with.



Beef up your passwords

How to lock down your online and offline accounts.

Do you rely on a limited number of passwords to secure accounts both online and off? You're not alone. The sad truth is, though, that this represents an opportunity for hackers and identity thieves who, once they crack one of your passwords, can often crack them all.

The way to solve this problem is to create unique, complex passwords for each account that you use, using a mix of upper and lowercase characters, numbers and even symbols. The trick then is remembering them all.

The solution lies in employing the services of a password manager. A good password management tool will generate strong random passwords, make them easy to access and protect them all behind a single, strong master password you can remember. You log into the password manager with the master password, and the rest of your passwords are then available.

PICK A PASSWORD

If you're super-concerned, or even paranoid, about security, you'll want to store your passwords offline, in which case you should look at KeePass (<http://keepass.info/>). Everything's stored locally, and you can add an extra layer of protection to your passwords by locking them using both a master password and a key file, which you

store on an external disk or drive. It's portable, too, so you can store everything on a USB flash drive and take your passwords with you on to other computers.

The biggest drawback with KeePass, however, is that it only works on your PC – if you want access to your passwords on your mobile, for example, then you'll need to be within reach of your machine to access them. If you're willing to store your passwords in the cloud (encrypted, of course), a more convenient option is to use a tool such as LastPass (www.lastpass.com).

LastPass offers a similar feature set to KeePass, minus the key file option. Instead, what it gives you is more convenience – you can install apps on your devices (including mobile ones) and use browser plug-ins to make it easier to log into sites – see the guide on the facing page – as well as generate strong, random passwords for new accounts. LastPass work with any service you access through your web browser, making it a good fit for your router, plus locally hosted servers such as Plex.

LastPass also offers secure notes and form-filling tools, for storing other sensitive information. You can also ask LastPass to prompt you for your master password each time you open a particularly sensitive note. LastPass also includes a security audit, which



2-Step Verification

To help keep your email, photos, and other content safer, complete the task below.



Enter a verification code

Get a verification code from the Google Authenticator app

☒ Don't ask again on this computer

Two-factor authentication and two-factor verification add an extra layer of security, by checking your identity using mobile devices.

checks all your passwords for weak ones, duplicates, passwords you haven't updated in a while and even accounts known to have been compromised.

All this functionality – including syncing across mobile and desktop – is free. Upgrade to the LastPass Premium package (around US\$24 per year) for more features, such as LastApp – a tool for using LastPass in conjunction with apps or programs on your device.

Even the strongest password can be guessed or cracked, so what happens if your password is leaked? The solution is to implement two-step verification or two-step authentication. This adds an extra step when logging into key accounts (including LastPass) on new devices. This can be as simple as an email notification, or you can implement a solution that requires your mobile phone or tablet to be at hand.

You can find out if your chosen service supports two-factor authentication by logging into it and exploring the security section of its settings – LastPass users should log into their account at www.lastpass.com and go to Account Settings > Multifactor Options, for example. From here you can pair it with the free LastPass Authenticator app.

One tip for additional security: what happens if your smartphone or tablet gets stolen? Make sure you tap Settings in LastPass Authenticator and flick the 'Use PIN Code' switch to On to protect it with a six-digit PIN. And remain wary of unexpected requests to use the authenticator app – it may indicate that a hacker has got your password and is hoping you can be tricked into verifying their request for access.

One-time app passwords

But some older devices and apps – including emails apps Thunderbird and Outlook – don't work nicely with it.

If you're a Google user, for example, go to accounts.google.com and sign in. Choose your username, then My Account. Click 'Sign-in & security', scroll down and click 'App passwords' beneath '2-step Verification'. Choose 'Select app' to give your app a name, and a device, then click Generate. Copy and paste the password into the relevant field (tick the option to save it). Now all should be well...





Windows security suites

NICK ROSS EXAMINES THE BEST SECURITY AND ANTI-VIRUS APPS FOR WINDOWS, BOTH FREE AND PAID.

If there's one universal truth about owning a PC, it's that you absolutely must have anti-malware software running on it. While this reality may grate, feel like an unfair tax, and have you be a constant butt of jokes from Apple's iDevice users, in a world where many peoples' lives are stored digitally online and where new, sophisticated forms of malware (including ransomware) are appearing

constantly, going without is just asking for trouble.

The good news is that there are virtually no barriers left to being protected. With the first Windows virus being discovered in 1992, for the first time the latest testing demonstrates that Windows' built-in protection may now actually be all you need. That's an extremely big call and, in an ever-changing threat landscape – where online perils are significant

and peace of mind is important – nobody should feel completely safe with it, just yet.

Nonetheless, the higher baseline provided by Windows Defender drives the market forward and highlights the importance of performance and high-quality features available in both free and premium packages. Our expectations are higher than ever.

As before we've chosen a best overall performer based upon performance

AV-TEST CONSUMER SECURITY SOFTWARE TEST RESULTS									
VENDOR	AHNLAB	AVAST	AVG	AVIRA	BITDEFENDER	BULLGUARD	COMODO	F-SECURE	G DATA
PRODUCT NAME	V3 INTERNET SECURITY	FREE ANTI-VIRUS	INTERNET SECURITY	ANTIVIRUS PRO	INTERNET SECURITY	INTERNET SECURITY	INTERNET SECURITY	SAFE	INTERNET SECURITY
PROGRAM VERSION	9.0	18.6 & 18.7	18.6 & 18.7	15.0	23.0	19.0	11.0	17	25.5
PROTECTION									
PROTECTION AGAINST 0-DAY MALWARE ATTACKS	98.6%	99.3%	99.3%	99.3%	100.0%	100.0%	100.0%	100.0%	99.3%
DETECTION OF WIDESPREAD AND PREVALENT MALWARE	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
PERFORMANCE									
PERFORMANCE IMPACT WHEN LAUNCHING POPULAR WEBSITES	12.3%	10.4%	17.5%	4.3%	12.8%	4.8%	19.6%	5.3%	57.4%
PERFORMANCE IMPACT ON DOWNLOAD OF FREQUENTLY-USED APPLICATIONS	1.5%	1.7%	1.5%	2.7%	1.3%	1.6%	1.4%	1.5%	1.4%
PERFORMANCE IMPACT ON LAUNCH OF STANDARD SOFTWARE APPLICATIONS	11.6%	16.7%	15.8%	9.3%	8.5%	12.7%	17.7%	4.3%	16.1%
PERFORMANCE IMPACT ON INSTALLATION OF FREQUENTLY-USED SOFTWARE APPLICATIONS	14.2%	26.3%	27.7%	21.5%	16.6%	22.4%	36.4%	41.0%	46.6%
PERFORMANCE IMPACT WHEN COPYING OF FILES, LOCALLY AND IN A NETWORK	1.5%	2.2%	2.3%	1.5%	2.4%	0.9%	4.2%	8.6%	13.3%
USABILITY									
FALSE WARNINGS OR BLOCKAGES WHEN VISITING WEBSITES	0	0	0	0	0	0	0	0	0
FALSE WARNINGS WHEN INSTALLING LEGITIMATE SOFTWARE	0	0	0	0	0	0	2	1	1
FALSE WARNINGS OF CERTAIN ACTIONS CARRIED OUT WHILST INSTALLING AND USING LEGITIMATE SOFTWARE	0	0	1	0	0	0	1	0	0
FALSE BLOCKAGES OF CERTAIN ACTIONS CARRIED OUT WHILST INSTALLING AND USING LEGITIMATE SOFTWARE	0	0	0	0	1	0	3	0	0
PROTECTION SCORE	5.5	5.5	5.5	6	6	6	6	6	6
PERFORMANCE SCORE	6	5.5	5.5	6	6	6	5	5.5	4
USABILITY SCORE	6	6	6	6	6	6	5	6	6
ACCUMULATED POINTS	17.5	17	17	18	18	18	16	17.5	16

and features. The best family option is for those who want set-and-forget protection for multiple devices that also offers parental controls to monitor and limit kids' online behaviour. Finally, there's a recommendation for the best free protection. In all groups we provide a runner-up for those who require something a little different.

Our performance testing has been conducted by the world-renowned AV-Test labs. These labs regularly test the most popular packages for malware protection, impact on system performance and false positives. All scores are listed in the table below. We also test for usability and design – when software is always running, we've little tolerance for pop-ups, unnecessary notifications and ads. While pricing is important, note that most premium packages are available in multiple versions at multiple price points. They all use the same core, protection engine but have different features, discounts and license durations.

What to look for

WHETHER YOU WANT A FREE OR A PREMIUM PACKAGE, BE AWARE OF THE FOLLOWING POINTS:

- 1

Behaviour-based detection is arguably the most important feature of any anti-malware package. Identifying potentially-damaging behaviours before they're formally identified is essential.
- 2

For free packages, check that 'free features' actually means free. Tricks include identifying issues but upselling you the fix.
- 3

If you can't afford the top-of-the-line product that you want, you can always buy the cheaper version (which uses the same protection engine) and use third-party add-on applications like 1Password, CCleaner or Carbonite.
- 4

Free backup space is good, but check how much extra storage costs should you want more.
- 5

Always shop around for discounts and long, free trials.
- 6

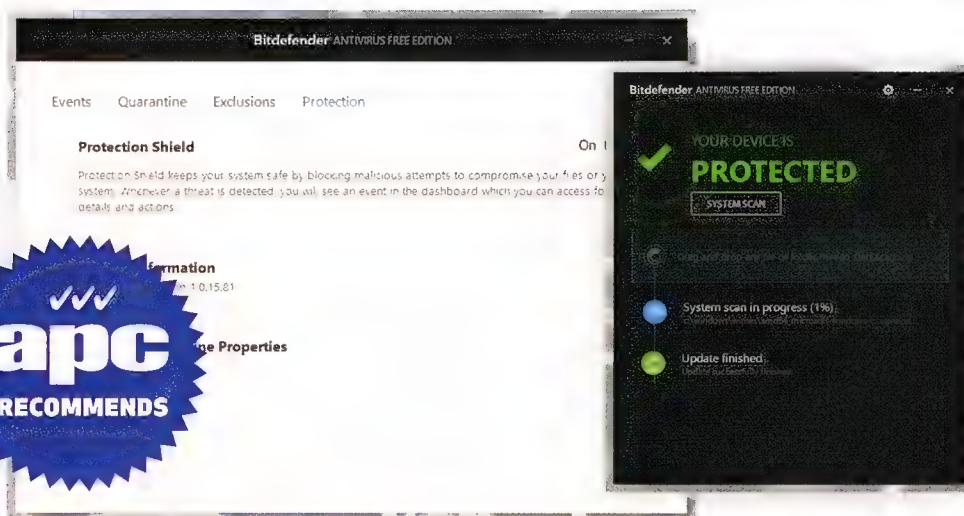
Premium software now regularly offers features like VPN, Backup, Parental Controls, webcam-intrusion monitoring, system tuning, and password management.
- 7

Ransomware protection is important, but only premium software offers a second-layer of folder-encryption protection.
- 8

Protection should be invisible: pop-ups, ads for extra features or scans while gaming are all unacceptable these days.

K7 COMPUTING	KASPERSKY LAB	MALWARE-BYTES	MCAFEE	MICROSOFT	MICROWORLD	PC PITSTOP	SYMANTEC	TREND MICRO	VIPRE SECURITY
TOTALSECURITY	INTERNET SECURITY	PREMIUM	INTERNET SECURITY	WINDOWS DEFENDER	ESCAN INTERNET SECURITY SUITE	PC MATIC	NORTON SECURITY	INTERNET SECURITY	VIPRE ADVANCED-SECURITY
15.1	19.0	3.5 & 3.6	21.4	4.18	14.0	3.0	22.15 & 22.16	12.0 & 15.0	10.3 & 11.0
99.3%	100.0%	97.2%	98.6%	99.3%	100.0%	100.0%	100.0%	100.0%	100.0%
100.0%	100.0%	99.6%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
20.6%	17.2%	7.6%	3.6%	4.5%	10.7%	4.2%	8.3%	13.6%	9.2%
0.7%	1.5%	0.1%	0.4%	1.3%	1.7%	0.3%	0.6%	0.2%	2.7%
9.7%	11.8%	31.1%	10.1%	9.4%	8.0%	6.5%	12.9%	23.8%	11.7%
10.5%	17.5%	64.6%	30.0%	50.9%	8.3%	8.9%	26.4%	24.2%	20.4%
3.6%	2.1%	1.9%	1.4%	1.4%	1.1%	0.6%	2.2%	3.8%	0.8%
0	0	0	0	0	0	0	0	0	0
2	1	4	0	0	0	22	0	1	0
3	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	2	0	1	0
5.5	6	4	5.5	5.5	6	6	6	6	5.5
6	6	5	6	5.5	6	6	6	5.5	6
5.5	6	4.5	6	6	6	3.5	6	6	6
17	18	13.5	17.5	17	18	15.5	18	17.5	17.5

BEST FREE VERSION



Critical specs: behavioural detection, web attack prevention, anti-phishing and anti-fraud.

FREE | WWW.BITDEFENDER.COM.AU

BEST FREE RUNNER-UP

Windows Defender

Credit where it's due, for the first time in almost thirty years, it may be fair to say that Windows doesn't need additional security anymore. It's a top performer in AV-Test's challenges, can protect against ransomware and can even fix tricky problems before Windows boots. It shouldn't be surprising considering Microsoft uses major security labs to support it and this is amplified by data from squillions of Windows users. Let's see consistency in future tests... then we'll consider recommending it.

Bitdefender Free Edition

It eschews shoddy trialware, limited functionality, ads and other annoyances for just really good protection.

While ploughing through all the usual suspects to find the best free anti-malware package, we came to several disturbing (and yet liberating) conclusions. The first was that literally all of the feature-packed free versions are annoying at best and dishonest at worst. Some flash up ads, others install affiliate shopping links (that they call 'safe shopping'), many offer performance scans for free but are rendered utterly pointless as the fix requires payment. Others offer VPN features with so little free data that they're borderline useless without subscribing to a premium version.

In practically every case, you can find much better, third-party applications without going through this rigmarole that invariably leads to a paywall of disappointment. In many ways we admire Symantec's anti-free-version stance; it says they're: "less robust, overzealous and can slow users down."

That said, Bitdefender's Free Edition offers all of its group-test winning core security features for free and nothing else. It doesn't bother you to upgrade or suggest features to pay for. While you won't get specialist apps like folder locking and webcam intrusion prevention, you do get its behavioural

protection, which helped it to a perfect score in AV-Test.

This means it blocked all malware including new, zero-day attacks plus web and email threats. It also detected all AV-Test's collection of prevalent threats from the previous month. As with its premium-version big brother, it scored no false positives when visiting websites or scanning applications. It's only (minor) failure was blocking the installation of an application it deemed suspicious.

When downloading applications it slowed the test PC down by just 1.3%, which rose to 8.5% when launching applications. Performance impact when installing applications was 16.6% and when copying files it was 2.4%. While other packages may have scored better in individual areas, these were all impressive scores and nothing else performed so consistently well.

Consequently, it offers less system impact and better

protection than many premium competitors. If you want password protection, get 1Password or use Chrome's manager. Performance tune-ups are still freely available from tools like CCleaner. Even the premium packages charge for extra for proper VPNs and Backup but you can still get great value from TorGuard and Carbonite.

In past tests, Avira has regularly come top and it still offers decent protection for free. But arguably none of the 'extra' features are worth having anymore. The VPN only offers 500MB per month!

Some may like the idea of having all security features in one place, Bitdefender Free Version's price will make them think again.

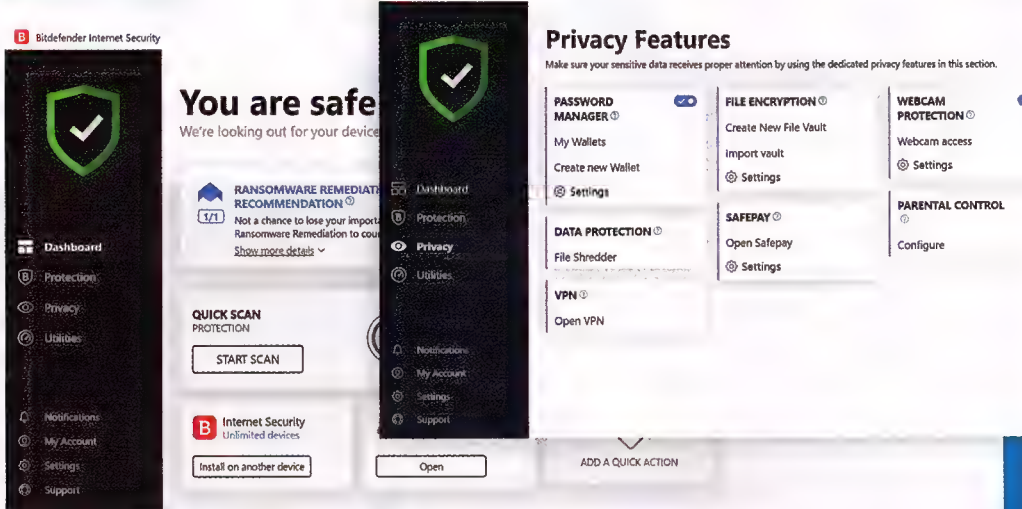
Verdict

A remarkably clean and competent basic protection package.



"Bitdefender's Free Edition offers all of its group-test winning core security features for free and nothing else."

BEST OVERALL



Critical specs: behavioural detection, network threat prevention, multi-layer ransomware, protection, SafePay shopping and banking browser, anti-theft, webcam intrusion, file encryption, password manager, file shredder, basic parental controls.

\$70 FOR FIVE DEVICES FOR ONE YEAR | WWW.BITDEFENDER.COM.AU

Bitdefender Total Security



Brimming with features, this top performer is great value and elegantly designed.

Regular readers won't be surprised: the Bitdefender juggernaut keeps on rolling. This monster with ballerina's feet doesn't just offer a complement of features that's unrivalled in the market, it does so while maintaining best-in-class protection and minimal system impact. As if that's not enough, it's also one of the best-looking packages with slick design and intuitive access to all of those features. That it's available in a multitude of versions, all of which are great value, is almost a footnote.

It achieved a perfect score in AV-Test with almost no false positives – there was a single instance where it blocked the installation of a file where that it thought was suspicious. While all security software slows down the launch of

applications and websites to some extent, few were as consistently discreet as Bitdefender. There's even a feature called Photon which adapts the package to your system's hardware and software environment in an effort to further lessen impact as time goes on.

A core feature of Bitdefender's protection comes from behavioural protection but it goes the extra mile in other areas. Not content with offering ransomware protection it offers folder protection to allow only defined apps the ability to write to them. In addition, Ransomware Remediation can automatically restore files when an attack gets blocked.

The feature list is huge and includes Web Attack Prevention which checks links before you click on them, Network Threat

Prevention to monitor potential threats on your local network, Anti-Theft tools to protect your computer and lock-it down remotely, one-click performance optimisations, Game, Movie and Work modes to avoid distractions, a battery mode to reduce high-performance tasks when away from the mains, password management, social network protection and a file shredder. Even webcam access is protected.

We're particularly impressed with its File Vault which creates a secure, password-protected folder that appears as a disk partition. There's also SafePay which is a browser you can use for shopping and banking plus a secure wallet for storing credentials.

There are few weak points. The Parental Controls have been

improved but aren't at the level where you can leave them to babysit your child – you can still block apps and sites and get reports on behaviour. The VPN may disappoint some. It offers 200MB of use per day when connecting automatically to an unknown location. If you want to choose your endpoint and get unlimited data you'll need to pay \$50 more per year.

Bitdefender is available at many, highly-customisable price points and it's regularly heavily discounted. At \$70 per year it's a bargain.

BEST OVERALL RUNNER-UP Kaspersky Total Security

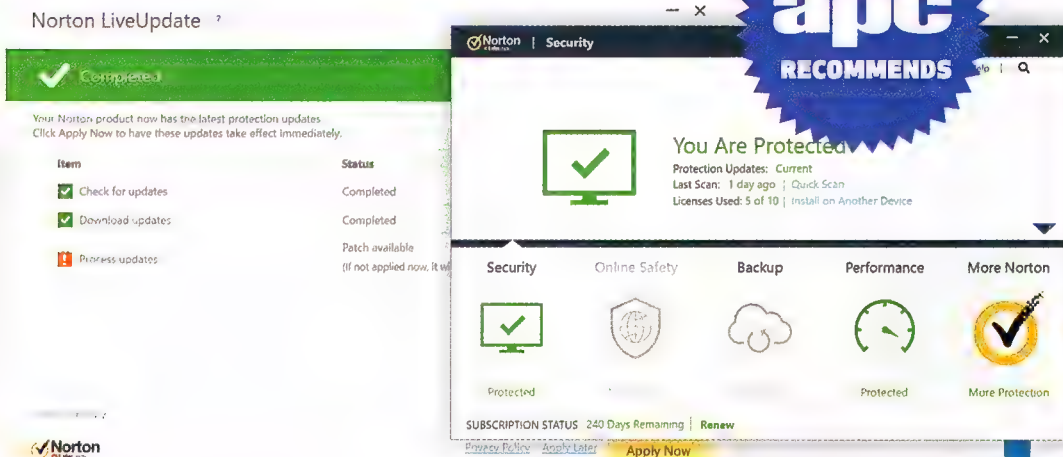
Once again Kaspersky finishes a close second. Offering many of the features that Bitdefender does, it's a great package that scored perfect results in AV-Test's security results with minimal slowdowns and only one false positive. It too comes discounted but still costs \$20 more while covering two fewer devices. Despite improvements, it also feels a bit old-school with its pop-ups and technical notifications. These may appeal to security buffs but Bitdefender's more-passive nature has it beat.

Verdict

Powerful protection, an abundance of features and a slick interface – all at a compelling price.



BEST FOR FAMILIES AND BEGINNERS



Critical specs: Behavioural detection, financial info protection, premium tech support, included protection for Mac, Android and iOS, extensive family safety features, 25GB backup, password manager.

\$95 FOR FIVE DEVICES FOR ONE YEAR | [HTTPS://AU.NORTON.COM](https://au.norton.com)

BEST FOR FAMILY RUNNER-UP

Trend Micro Maximum Security

Trend Micro is another simple to use option with some good family-friendly features. Among them is a hardware security device which plugs into your router and protects all network devices. However, everything costs more than with Norton and, despite scoring almost top marks with AV-Test for security, isn't quite as unobtrusive as rivals. Still, additional features like social media privacy settings and its new Pay Guard may tempt people into paying an extra \$10 per year.

Norton Security Premium Household

Once you install it you'll barely know it's there.

We suspect there are still a few people who wince at the thought of Norton. Some 15 years ago it was an un-installable nightmare that could arguably be best described as malware. To its credit, the company realised this, rebuilt it from the ground up and integrated backup technology from what was Norton Ghost to make one of the most efficient pieces of security software around.

It's fair to say that the competition has since caught up, but Norton still offers a slick, set-and-forget experience that can't be beat. If you're not interested in bells and whistles and just want your family's devices protected knowing that the software won't badger them about anything, this is the product to buy.

It's not particularly cheap at \$95 for five devices for one year (with discounts), but

once purchased you have peace of mind that it won't stop working, screw anything up or confuse tech-novice users into doing something silly. It also covers all major mobile devices.

Norton was one of the pioneers of behavioural security and we aren't surprised to see it score 100 per cent in the security tests. It even managed to edge ahead of Bitdefender when it came to system impact: causing less delay when launching websites and downloading programs. AV-Test also recorded zero false positives with websites and programs.

Backup is included but you only get 25GB before you must pay for more. VPN functionality is separate and costs \$75 per year. Performance tuning is included and Norton SafeSearch is a popular browser extension that protects against bad links. A

"Norton still offers a slick, set-and-forget experience that can't be beat."

noteworthy mention is Norton Core – a high-performance, funky-looking, Geodesic dome-shaped, secure, Wi-Fi router which locks down your network and offers family management options not seen elsewhere. At just \$98 with bundled software, you effectively get Norton's top software security package for free. Just note, the router is easy to use but isn't great if you use low-latency applications like gaming.

Without the Core, Norton still offers some of the best Family protection options around. You can set up child profiles, house rules and timers to ensure they don't spend too long on computers (or mobile devices) and

ensure they're not using them at certain times. Everything can be monitored including location, web searches, social media and video watching. It's all accessible from a slick and intuitive web portal.

Norton used to be the easy choice, but the competition has caught up. However, as a family-friendly set-and-forget option for those who aren't bothered about paying a bit more, it's still the best.

Verdict

Our top choice for simple set and forget protection.



SUBSCRIBE & GET APC FROM ONLY \$5.79 AN ISSUE!

12

ISSUES FOR ONLY \$79!

WHY SUBSCRIBE?

- Take advantage of our trial subscription offer of six issues for \$49 if you choose to auto-renew*
- Get 12 issues of Australia's favourite tech mag for only \$79!
- Save even more and get 24 issues for \$139 — that's just \$5.79 per issue!
- Free delivery of every issue straight to your door
- Free full-version software downloads with every issue

SAVE UP TO \$99.80!

BE 5G READY. GET PRIMED FOR **ULTRA SPEEDS**



FREE DELIVERY TO YOUR HOME
OR OFFICE EACH MONTH

HURRY

OFFER ENDS MAR 25TH 2019!

TWO EASY WAYS TO SUBSCRIBE TO APC MAGAZINE

VISIT WWW.TECHMAGS.COM.AU

OR CALL (02) 8227 6486

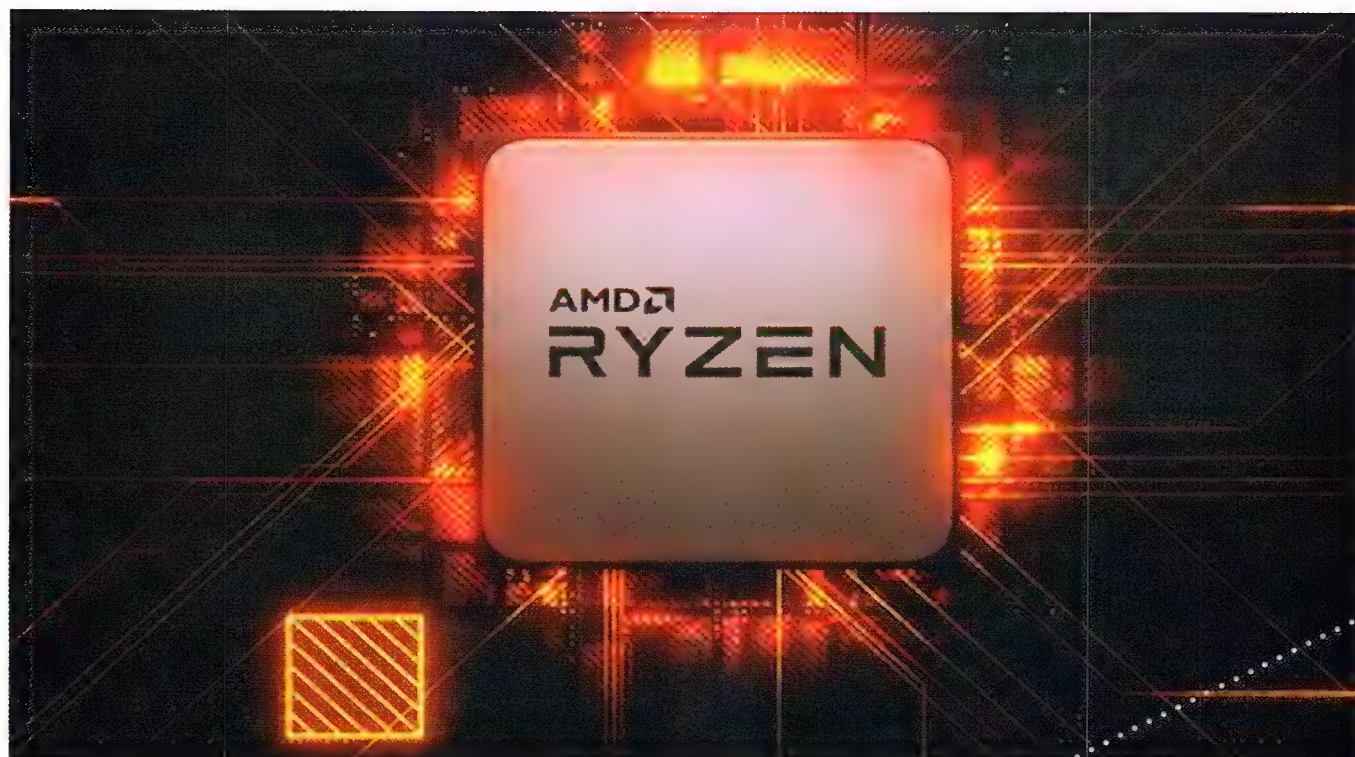
TERMS & CONDITIONS: This offer expires March 25th, 2019, and is available to subscribers within Australia only. Please allow 6-8 weeks for delivery of your first issue. For full terms and conditions, see: <http://techmags.com.au/style/images/FutureTC.pdf>. Please see our privacy policy on page 3. *Six issues for \$49, then \$49 charged to your credit or debit card every six issues thereafter on auto-renewal.

// CES

2019

// THE YEAR AHEAD
IN PC TECH

BOMBSHELLS GALORE FROM
AMD, NVIDIA, AND INTEL,
PLUS MONITOR INNOVATION
CONTINUES TO EXPLODE.



AMD Ryzen 3rd gen 'Matisse' coming mid-2019

EIGHT CORE ZEN 2 WITH PCIE 4 ON THE DESKTOP-MEMORY.

IAN CUTRESS

AMD's keynote address this year was a whirlwind of primetime announcements for the company. The message is clear: AMD is committing itself to 7nm as the future process node that will drive the company's innovations starting in 2019. The first consumer products on 7nm will be the Ryzen 3rd Generation Desktop processors, using Zen 2 cores, offering more than competitive performance against Intel's best hardware. Also on the docket is a return to high-end graphics performance, with AMD set to release a 7nm graphics card that can spar blow-for-blow with the competition.

First up, CPUs. AMD presented its next generation 7nm desktop CPU,

which is the 3rd Generation Ryzen. The new parts, codenamed Matisse, will be coming to market in mid-2019 (sometime in Q2 or Q3). The processor the company had on display was made from two pieces of silicon on the package: one eight-core 7nm chiplet made at TSMC, and a 14nm input/output chiplet with the dual memory controllers and the PCIe lanes, made at GlobalFoundries.

The company did state that it is the world's first 7nm gaming CPU, and will also be the world's first mainstream CPU to support PCIe 4.0 x16. At this time the company is not commenting on if the 3rd Gen is going to have a maximum of eight cores, or if this represents the best processor of the whole family.

PCIE 4.0 GAINING GROUND

Because the processor is still far away from launch, frequencies are not being finalised yet. However, the processor is for the AM4 socket, given that AMD has previously said that it intends to keep backwards compatibility for several generations. That will mean that this CPU will work in current 300 and 400-series AMD motherboards. What this means for PCIe 4.0 is actually fairly simple. We expect there to be a new line of motherboards presumably something like X570 that will be PCIe 4.0 compatible, for any new PCIe 4.0 graphics cards that will be coming to market. One of the differences with PCIe 4.0 is that it can only handle PCB traces up to 18cm before needing a redriver/retimer, so

"This new 3rd Generation Ryzen processor scored 2023. This would mean that at current non-final clocks, the new parts give a 15.3% increase in performance generation on generation."

these extra ICs are needed for ports lower down the board. But, the first PCIe slot on most motherboards is in that limit, so it would appear that a lot of current 300 and 400 series motherboards, assuming the traces adhere to signal integrity specifications, could have their first PCIe slot rated at PCIe 4.0 with new firmware.

AMD showed some performance numbers using the new Ryzen 3rd Generation (Matisse) processor. The test in question was Cinebench R15. Our internal numbers show the 2nd Generation Ryzen 7 2700X scores 1754. This new 3rd Generation Ryzen processor scored 2023. This would mean that at current non-final clocks, the new parts give a 15.3% increase in performance generation on generation. Cinebench is an idealised situation for AMD, but this is not at final clocks either. It will depend on the workload, but this is an interesting data point to have.

IDENTICAL PERFORMANCE TO THE CORE I9-9900K, MINIMUM

Our internal benchmarks show the 9900K with a score of 2032. The 8-core AMD processor scored 2023, and the Intel Core i9-9900K scored 2042. Both systems were running on strong air cooling, and we were told that the Core i9-9900K was allowed to run at its standard frequencies on an Asus motherboard.

The AMD chip, by contrast, was not running at final clocks. AMD said that both systems had identical power supplies, DRAM, SSDs, operating

systems, patches, and both with a Vega 64 graphics card.

AT JUST OVER HALF THE POWER...

Also, in that same test, it showed the system level power. This includes the motherboard, DRAM, SSD, and so on. As the systems were supposedly identical, this makes the comparison CPU only. The Intel system, during Cinebench, ran at 180W. This result is in line with what we've seen on our systems, and sounds correct. The AMD system on the other hand was running at 130-132W.

If we take a look at our average system idle power in our own reviews, which is around 55W, this would make the Intel CPU around 125W, whereas the AMD CPU would be around 75W.

This suggests that AMD's new processors with the same amount of cores are offering performance parity in select benchmarks to Intel's highest performing mainstream processor, while consuming a lot less power. Almost half as much power.

HOW HAS AMD DONE THIS? IPC OR FREQUENCY?

We know a few things about the new Zen 2 microarchitecture. We know it has an improved branch predictor unit, and improved prefetcher, better micro-op cache management, a larger micro-op cache, increased dispatch bandwidth, increased retire bandwidth, native support for 256-bit floating point math, double size FMA units, and double size load-store units. These last three parts are key elements to an FP-heavy benchmark like

Cinebench, and work a lot in AMD's favour.

As the Intel CPU was allowed to run as standard, even on the Asus board, it should reach around 4.7 GHz on an all-core turbo. AMD's frequencies on the processor were unknown; but also they are not final and we 'should expect more'. Well, if the processor was only running at 75W, and they can push it another 20-30W, then there's going to be more frequency and more performance to be had.

The one thing we don't know is how well TSMC's 7nm performs with respect to voltage and frequency. The only chips that currently exist on the process are smartphone chips that are under 3GHz. There is no comparable metric – one would assume that in order to be competitive with the Core i9-9900K, the processor would have to match the all-core frequency (4.7 GHz) if it was at the same IPC.

If the CPU can't match IPC or frequency, then three things are possible:

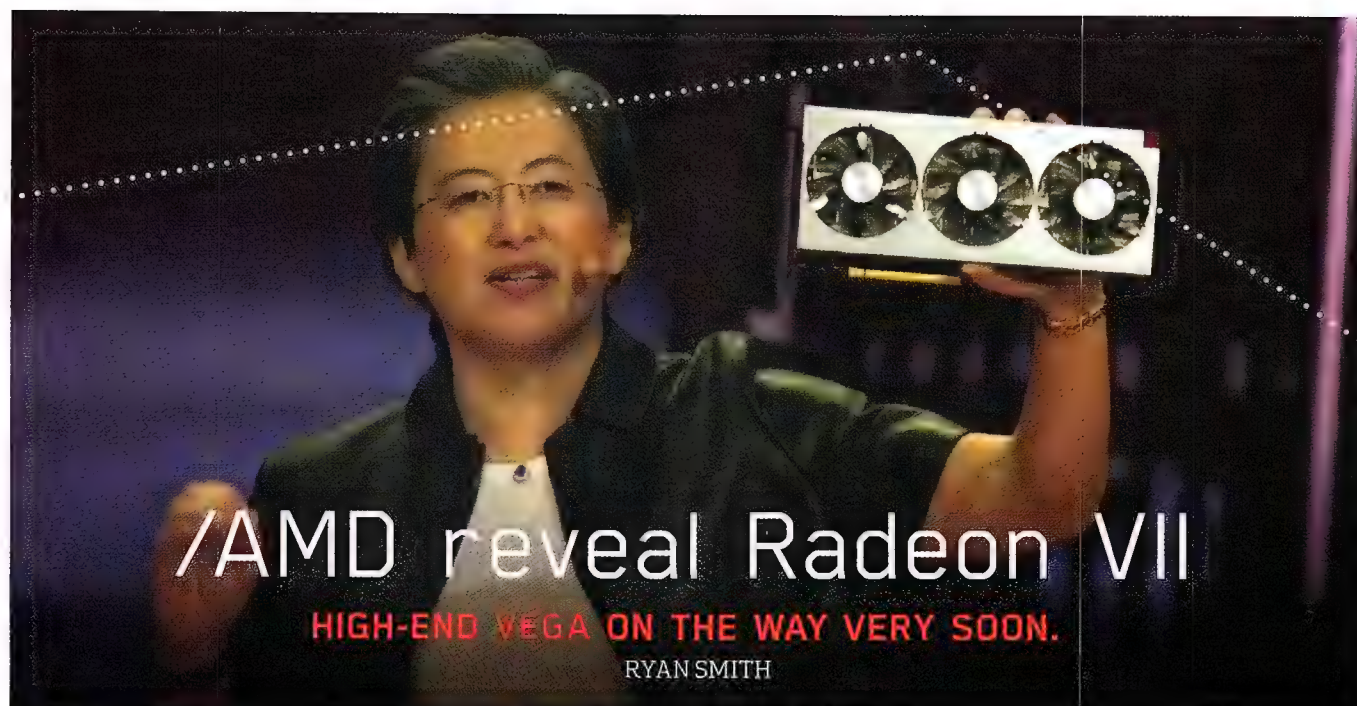
- 1 If the TSMC process can't go that high on frequency, then AMD is ahead of Intel on IPC, which is a massive change in the ranks of modern x86 hardware.
- 2 If the TSMC process can clock above 5GHz, and there is room to spare in the power budget to go even higher, then it's going to be really funny seeing these processors compete.
- 3 AMD's Hyperthreading for software such as CineBench is out of this world.



RYZEN

3RD GENERATION
AMD RYZEN™
DESKTOP PROCESSOR

AVAILABLE MID-2019



RYAN SMITH

As it turns out, the video card wars are going to charge into 2019 quite a bit hotter than any of us were expecting. As part of AMD's CES 2019 keynote, CEO Dr. Lisa Su announced that AMD will be releasing a new high-end, high-performance Radeon graphics card. Dubbed the Radeon VII (Seven), AMD has its eyes set on countering Nvidia's previously untouchable GeForce RTX 2080.

This announcement was interesting in that it's just as much about technology as it is the 3D chess that is the market positioning fights between AMD and Nvidia. Technically AMD isn't announcing any new GPUs here, but the situation in the high-end market

has played out such that there's now a window for AMD to bring its cutting-edge Vega 20 GPU to the consumer market, and this is a window AMD is looking to take full advantage of.

TAKE THAT, GTX 2080

At a high level then, the Radeon VII employs a slightly cut down version of AMD's Vega 20 GPU. With 60 of 64 CUs enabled, it actually has a few fewer CUs than AMD's previous flagship, the Radeon RX Vega 64, but it makes up for the loss with much higher clockspeeds and a much more powerful memory and pixel throughput backend. As a result, AMD says that the Radeon VII should beat their former flagship by anywhere between 20% and 42%

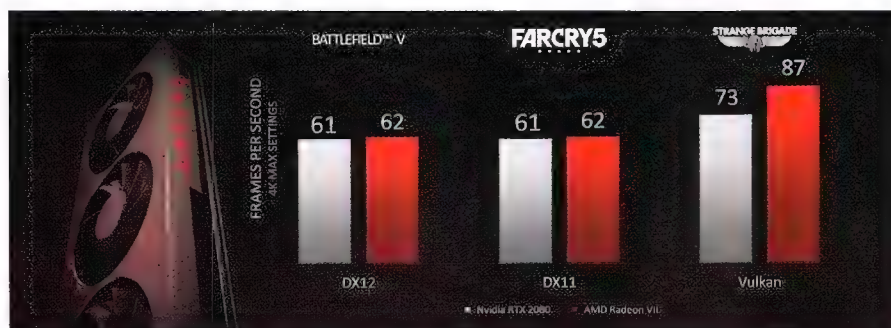
depending on the game (with an overall average of 29%), which on paper would be just enough to put the card in spitting distance of Nvidia's RTX 2080, and making it a viable and competitive 4K gaming card.

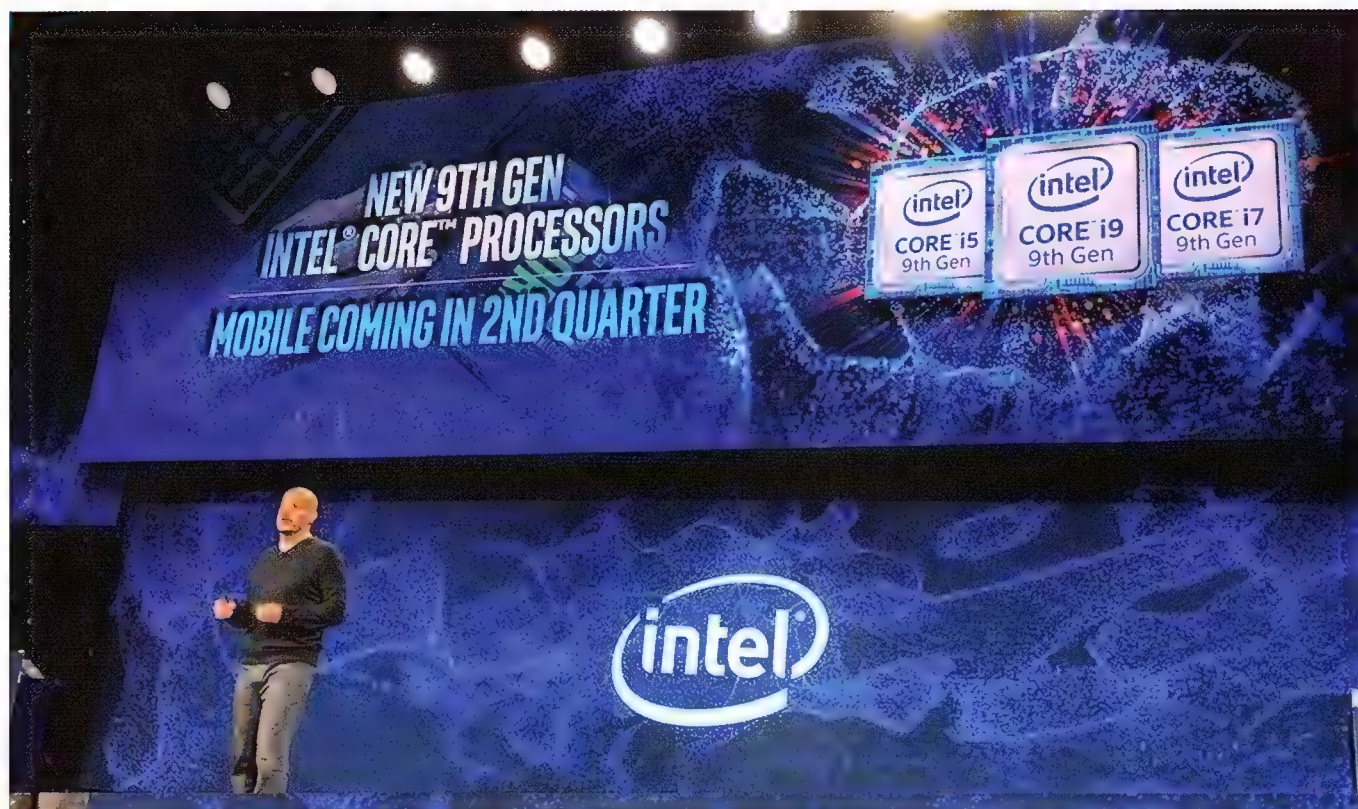
Diving into the numbers a bit more, if you took AMD's second-tier Radeon Instinct MI50 and made a consumer version of the card, the Radeon VII is almost exactly what it would look like. It has the same 60 CU configuration paired with 16GB of HBM2 memory. However the Radeon VII's boost clock is a bit higher – 1800MHz versus 1746MHz – so AMD is getting the most out of those 60 CUs. Still, it's important to keep in mind that from a pure FP32 throughput standpoint, the Vega 20 GPU was meant to be more of a sidegrade to Vega 10 than a performance upgrade; on paper the new card only has a 9% compute throughput advantage. So it's not on compute throughput where Radeon VII's real winning charm lies.

Instead, the biggest difference between the two cards is on the memory backend. Radeon Vega 64 (Vega 10) 2 HBM2 memory channels running at 1.89Gbps each, for a total of 484GB/sec of memory bandwidth. Radeon VII (Vega 20) doubles this and then some to 4 HBM2 memory channels, which also means memory capacity has doubled to 16GB. And then there's the clockspeed boost on top of this to 2.0Gbps for the HBM2 memory. As a result Radeon VII has a lot memory bandwidth to feed itself, from the ROPs to the stream processors. Given these changes and AMD's performance estimates, I think this lends a lot of evidence to the idea that Vega 10 was underfed – it needed more memory bandwidth to keep its various processing blocks working at full potential – but that's something we'll save for the eventual review.

AMD RADEON SERIES SPECIFICATION COMPARISON

	AMD RADEON VII	AMD RADEON RX VEGA 64	AMD RADEON RX 590	AMD RADEON R9 FURY X
STREAM PROCESSORS	3840 (60 CUS)	4096 (64 CUS)	2304 (36 CUS)	4096 (64 CUS)
ROPS	128/64	64	32	64
BASE CLOCK	?	1247MHZ	1469MHZ	N/A
BOOST CLOCK	1800MHZ	1546MHZ	1545MHZ	1050MHZ
MEMORY CLOCK	2.0GBPS HBM2	1.89GBPS HBM2	8GBPS GDDR5	1GBPS HBM
MEMORY BUS WIDTH	4096-BIT	2048-BIT	256-BIT	4096-BIT
VRAM	16GB	8GB	8GB	4GB
SINGLE PRECISION PERF.	13.8 TFLOPS	12.7 TFLOPS	7.1 TFLOPS	8.6 TFLOPS
BOARD POWER	300W?	295W	225W	275W
MANUFACTURING PROCESS	TSMC 7NM	GLOFO 14NM	GLOFO/SAMSUNG 12NM	TSMC 28NM
GPU	VEGA 20	VEGA 10	POLARIS 30	FIJI
ARCHITECTURE	VEGA (GCN 5)	VEGA (GCN 5)	GCN 4	GCN 3
TRANSISTOR COUNT	13.2B	12.5B	5.7B	8.9B





New 9th Gen CPUs

AND INTEL SURPRISES WITH A HYBRID SSD.

PAUL ALCORN

Intel's Senior Vice President of the Client Computing Group Gregory Bryant defined what Intel calls the "new era of computing" during Intel's CES keynote. This includes several technologies, like cloud-based solutions, desktop PCs, 5G networking, AI, and data centre products, among others.

Intel is launching six new 9th-Generation processors for the desktop PC that range from Core i3 up to Core i9, and says the first new 9th-Gen processors will come to market this month, with more rolling out through the second quarter of this year.

Bryant then displayed a 10nm Ice Lake processor that comes with Gen11 graphics, native Thunderbolt 3, WiFi-6, and artificial intelligence (boosted by DL Boost) into a single SoC. Intel

demonstrated the Ice Lake chip offering a 2x performance boost to processing images. The company also demoed an Ice Lake system playing a game while using Thunderbolt 3 to connect to a storage device and a display.

The new 10nm Ice Lake processors will come to market in high volume in 2019. These chips come with a 2.7X density improvement over the 14nm process that Intel currently uses for its processors. The long-overdue 10nm process should let Intel create cheaper and more power efficient chips as a byproduct of the improved density.

The Sunny Cove microarchitecture is the first new design that Intel can use on multiple nodes. Intel has typically used the same naming convention for its microarchitectures as it does for its processors. Hence, Skylake processors

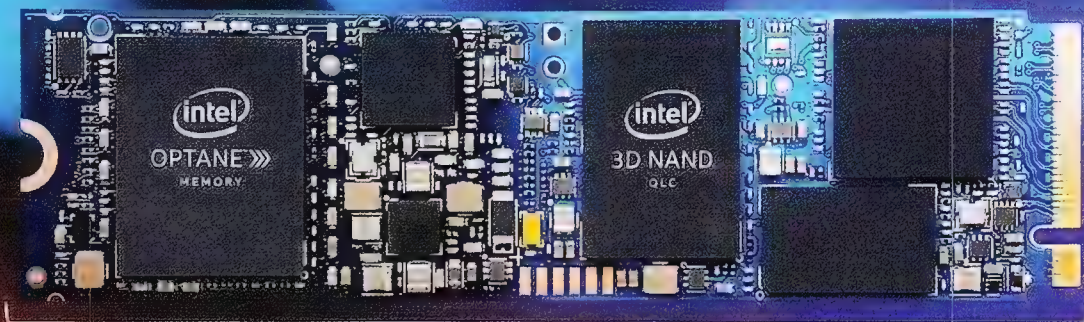
came with the Skylake architecture, and Kaby Lake processors came packing the Kaby Lake architecture. That old paradigm changes now that Intel has decoupled its architectures from the end products, so the 10nm Ice Lake chips come with Sunny Cove cores. The chips will bring higher performance in single-threaded applications, a new instruction set architecture (ISA), and a design geared for scalability.

NEW OPTANE M.2: OPTANE + QLC FLASH

Intel's speedy Optane storage products just received a face-lift. The new Optane Memory H10 model boosts overall storage capacity by pairing the speedy 3D XPoint memory with a dollop of QLC flash. That means there will soon be Optane-powered SSDs that

INTEL® OPTANE™ MEMORY H10 WITH SOLID STATE STORAGE

Add responsiveness and capacity to your computer with the intelligent combination of Intel® Optane™ memory and Intel® QLC 3D NAND Storage in one M.2 form factor.



INTEL® OPTANE™ MEMORY

Accelerate your PC with breathtaking responsiveness so you can search and find what you need faster and launch applications quicker. Optane memory automatically learns your computing patterns to optimize performance for frequent tasks. Combine with 1TB of storage capacity in

INTEL® QLC 3D NAND

Get large capacity with Intel® QLC 3D NAND that packs more data into a smaller footprint. Fits in small spaces with its versatile M.2 form factor designed for mobile devices or desktops. Transfer data at PCIe® speeds unleashing the full power of QLC, getting you from data to productivity faster.

reach up to 1TB of capacity.

As you can see in the image, the M.2 SSD features both a QLC flash and an Optane memory package on a single PCB. The new drives use the fast Optane storage to accelerate frequently-accessed data held on the more spacious QLC flash, meaning these M.2 drives will come in one slim package with higher capacities than the previous-gen M.2 Intel SSD 800p.

The 800p SSDs only come in capacities of 58GB and 118GB and are significantly more expensive than typical flash-based SSDs. Intel's new H10 drives will still command a premium due to the pricey Optane memory, but the less-expensive QLC flash means you get much more storage capacity for your dollar. The new Optane Memory H10 drives include two models with either 1TB or 512GB of QLC flash paired with 32GB of Optane memory. Intel also has a low-capacity model that combines 256GB of QLC storage with 16GB of Optane memory.

The H10 is essentially a 32GB Optane memory caching drive and an Intel 660p QLC SSD crammed onto a single board. As such, the drive has a custom Intel controller for the Optane memory and a separate SMI controller for the QLC flash. Each controller has its own PCIe 3.0 x2 pathway into the M.2 socket, and Intel's RST (Rapid Storage Technology) combines the two drives together. As a result, the drive is limited to the speed of a single PCIe 3.0 x2 connection. That will limit performance for large transfers, but

you retain the speed and latency of Optane during random workloads.

OPTANE STILL TRICKY TO CONFIGURE

The Optane memory is transparent to the operating system, so the drives only expose the QLC flash portion of the SSD to the user. As such, a drive with 1TB of QLC flash and 32GB of Optane memory appears as a 1TB drive. Most enthusiasts use the smaller Optane SSD 800p drives to hold their operating system while storing bulk data, like games, pictures, and videos, on a secondary drive. That tactic isn't as effective in the notebook space, largely because most lightweight devices don't come with connections for a secondary drive.

The new drives will certainly open up new opportunities for notebook users, and for Intel. The new drives will debut in Q2 in OEM systems from Dell, Lenovo, HP, Acer, Asus, and others.

Intel is leading with drives for several OEM laptops, which will come to market in Q2 2019, but hasn't committed to bringing retail models to shelves. The H10 requires a motherboard that supports PCIe bifurcation, which means motherboard vendors would have to commit to releasing new BIOS revisions that support the feature.

Intel hasn't released performance specifications. QLC SSDs tend to be pretty snappy, but regular Optane drives are faster. Overall performance of the combined drives will not be as impressive as a "pure" Optane SSD, but intelligent caching should make the drive faster than flash-based SSDs.

Intel hasn't released specifics, but the Optane Memory H10 SSDs have a higher endurance rating than a standard QLC SSD and are backed by a five-year warranty.

INTEL NEW 9TH GEN

CORES / THREADS	BASE / BOOST FREQ. (GHZ)	INTEGRATED GRAPHICS	MEMORY SUP. PORT	CACHE	TDP	RCP
CORE i9-9900K	8/16	3.6/5.0	UHD 630	DDR4-2666	16MB	95W
CORE i9-9900KF	8/16	3.6/5.0	NO	DDR4-2666	16MB	95W
CORE i7-9700K	8/8	3.6/4.9	UHD 630	DDR4-2666	12MB	95W
CORE i7-9700KF	8/8	3.6/4.9	NO	DDR4-2666	12MB	95W
CORE i5-9600K	6/6	3.7/4.6	UHD 630	DDR4-2666	9MB	95W
CORE i5-9600KF	6/6	3.7/4.6	NO	DDR4-2666	9MB	95W
CORE i5-9400	6/6	2.9/4.1	UHD 630	DDR4-2666	9MB	65W
CORE i5-9400F	6/6	2.9/4.1	NO	DDR4-2666	9MB	65W
CORE i3-9350KF	4/4	4.0/4.6	NO	DDR4-2400	8MB	91W
CORE i3-8100F	4/4	3.6/-	NO	DDR4-2400	6MB	65W

Bold indicates products released in 2018.

"RTX is coming to laptops: 40 machines will launch early in 2019, with 17 using Max-Q designs."



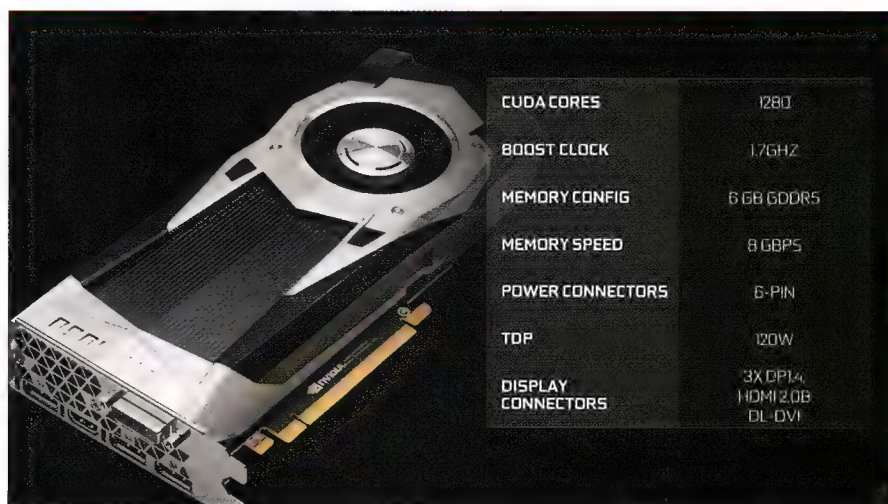
The expected, and a huge surprise

GTX 2060, MOBILE RTX AND INCREDIBLY NVIDIA CARDS NOW WORK WITH FREESYNC!

ANDREW E. FREEDMAN

Nvidia head Jensen Huang took the stage at a packed CES keynote briefing dedicated specifically to the company's gaming technology. He introduced the RTX 2060, the company's latest GPU and one capable of ray-tracing. It will debut with 52 trillion tensor FLOPs, 6 GB of G6 memory and 5 gigarays per second of performance. He additionally announced G-Sync Ultimate, a new driver that will make adaptive sync monitors work like those that already have Nvidia's proprietary technology, as well as RTX cards for laptops.

He showed it off with a demo of *Battlefield V*, with RTX on at 1440p. We saw a mission in the Battle of Rotterdam, and were pointed to how water reflects the sun and boats on the water. A building in the game was reflected on the water on a train car. Huang said that performance on games is "dramatically higher" than the GTX 1060, performing up to twice as well on *Wolfenstein II* and outpacing on other popular titles like *Call of Duty: Black Ops 4* and *Deus Ex: Mankind Divided*. "An RTX 2060 has higher performance than a 1070 Ti" he said, showing off a performance chart of several previous GPUs, including the GTX 960 and 970.



TURING FOR MOBILE

But this wasn't all about desktops. Huang reminisced about Max-Q and how power could be brought to laptops while also being low power and super-efficient. Now, RTX is coming to laptops: 40 machines will launch early in 2019, with 17 using Max-Q designs. Those Max-Q cards include the RTX 2070 Max-Q and 2080 Max-Q. "We optimise every single game for laptop use," Huang said.

G-SYNC ULTIMATELY

Another big announcement was the

G-Sync Ultimate, with new monitors: the Asus ROG Swift PG27UQ, HP Omen X Emporium 65 and the Acer Predator X27. These are "Nvidia tested and driver optimised." He mentioned A-Sync, or adaptive sync and suggested blanking and pulsing can ruin a game. They will use a driver to support adaptive sync, and if monitors pass specification, it will be considered G-Sync ready. This is taking on FreeSync in a very big way, and the driver is available now.



Display bonanza

MONITORS: STILL THE PRIME NEXUS OF PC INNOVATION.

KEVIN LEE

While CES 2019 was a flurry of excitement with 7nm and 10nm silicon, what interested us most were all the new computer monitors we feasted our eyes on. From gargantuan 65-inch displays to RGB lit spectacles, we've never seen this many monitors introduced at CES and there were also a fair share of newcomers to the scene as well.

HP OMEN X EMPERIUM 65

As its name suggest it's a massive 65-inch monitor and while it might not have a tuner like your 4K TV, it'll deliver impeccable image quality with its 4K UHD (3840 x 2160) resolution, 1,000-nit peak brightness, HDR colors, and a high refresh rate of 144Hz. What's more, this screen features a built-in sound bar and a built-in Nvidia Shield, so it could easily be the centre of your home entertainment setup just as much as your extra, extra-large gaming monitor.

Big Format Gaming Displays were one of our #1 highlights of CES 2018 and we were a little sad we didn't hear another peep about them for an entire year. Thankfully, the giant gaming monitors like this didn't evaporate into vaporware. Rather, HP has been hard at work perfecting the BFGD formula and the HP Omen X Emperium 65 is a stand out example of the monitors that will redefine PC gaming in the living room.

RAZER RAPTOR

At CES 2019, Razer officially jumped into the world of gaming monitors with the Raptor. This 27-inch gaming display looks like a stellar high-end set with a 2560 x 1440 IPS panel, a 144Hz refresh rate and support for AMD's FreeSync

variable refresh rate technology. Although Razer has said it will achieve 95% of the HDR-grade DCI-P3 color gamut, it didn't officially announce whether it will meet any of the HDR specifications.

Specs aside, it looks stunning with an industrial design and RGB lighting. It also has plenty of practical gimmicks as well, around back you'll find a cable routing area pre-etched into the back of the monitor stand and the monitor will also turn 90-degrees, allowing you to access the ports easily.

AORUS

Aorus was just one of the many gaming hardware makers to get into gaming monitors and its current flagship is the AD27QD Tactical Display. It features a 27-inch, 2,560 x 1,440 resolution IPS panel that supports a 144Hz refresh rate, FreeSync and 10-bit colours covering 95% of the DCI-P3 color space.

What makes this gaming monitor interesting is it comes with its own built-in microphones. These mics won't pipe your voice to your in-game teammates, rather they're designed to add noise cancelling for your gaming headset/microphone. All users have to do is connect a 3.5mm headset directly into the monitor and the monitor will be

able to mute out the sounds of your clacking keyboard, screaming Mum and other noises your teammates won't want to hear. Aorus' Tactical Advantage Monitor overlay can also activate frame-rate monitoring and a centre reticle to your screen – which may be useful for games like CS:GO and other shooters.

ALIENWARE 55 OLED MONITOR

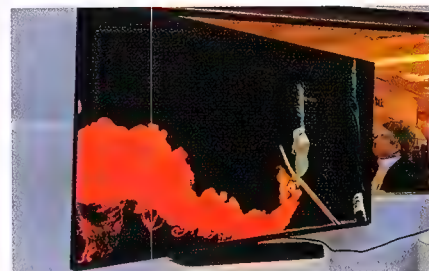
AT CES 2019, we saw plenty of large-format gaming monitor, but Alienware was the only company to introduce an OLED screen. The Alienware 55 OLED Monitor might only be a technology preview at this point, but we were still blown away by the rich blacks and vividly popping colors.

So far we know that the 55-inch OLED monitor will feature a 3840 x 2160 display resolution, 120Hz refresh rate and cover 98% of the DCI-P3 colour space.

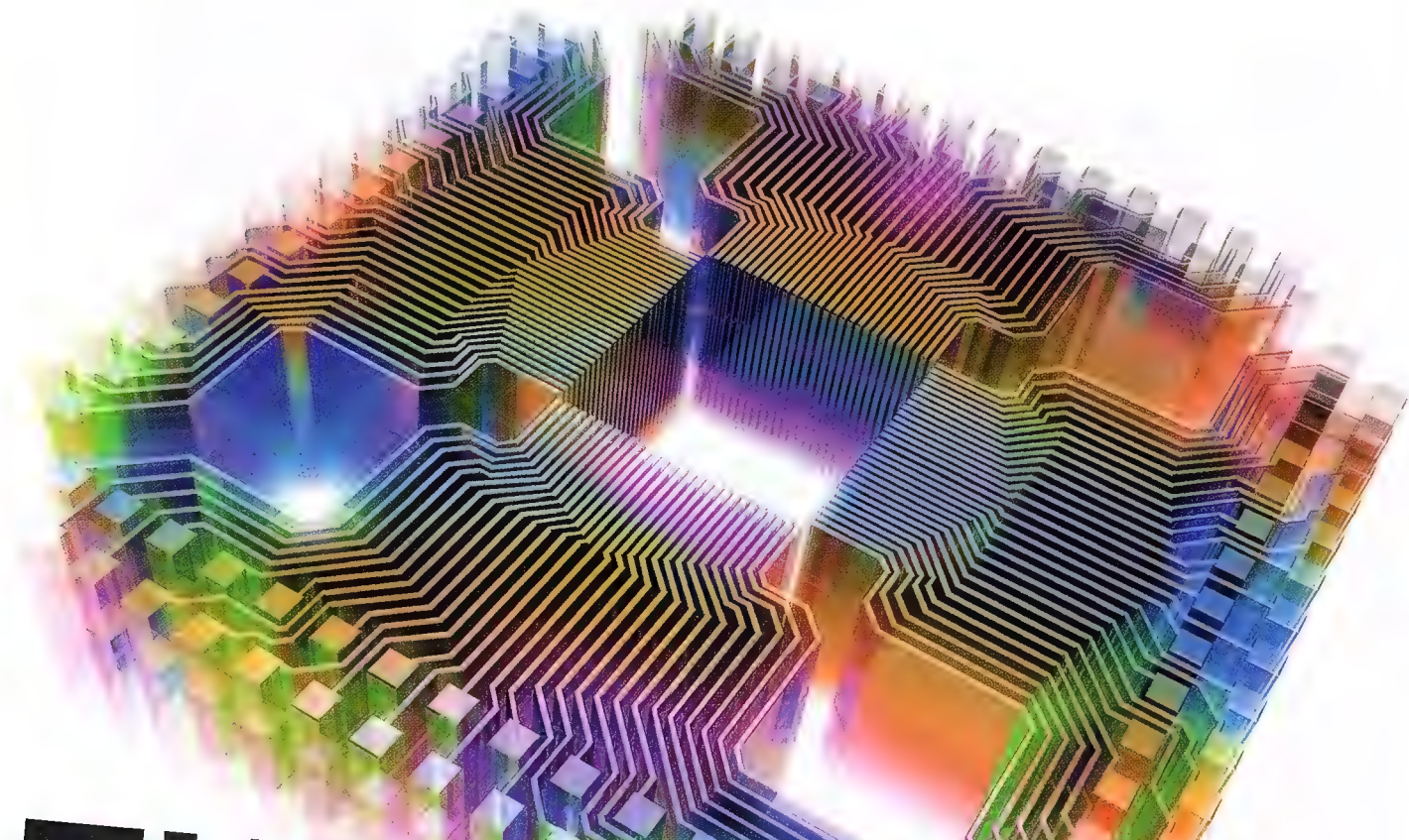
Unfortunately, Alienware is keeping its lips tight on peak brightness and HDR certifications. Also, while you might think that this monitor falls under Nvidia's BFGD banner, it doesn't. Alienware has yet to confirm if it will support either G-Sync or AMD's FreeSync either. Sadly, we won't know much more about the Alienware 55 OLED Monitor until it releases in mid-2019. ■



HP's 65-inch Emperium game monitor.



Alienware had the sole OLED monitor on show.



QUANTUM COMPUTING

Mats Tage Axelsson introduces you to quantum computing, the coolest tech around; learn how it works, and how you can get started.

Quantum computing has caught the attention of large companies, academics, and hobbyists. We're going to cover the history, the different ways to make a quantum computer, and the logic behind programming. You'll also learn about some programming toolkits that you can use to get started.

To run a quantum computer, the physics has to be understood, so programmers can manipulate and measure the final results. Scientists have observed quantum effects in photons, electrons, and isotopes of many materials. This means engineers use superconducting materials, such as niobium and aluminum, to construct workable quantum computing systems.

The logic gates are made of silicon

wafers, and are controlled using microwave emitters. These solutions may not be the best in the long run, but they're the ones that are running now. To use quantum computers, you need logic that takes advantage of the two core concepts: superposition and entanglement. When you start exploring these concepts, the Bloch sphere helps visualise what to do with different gates. Programmers can use classical bit gates together with quantum gates to create the algorithms needed.

The mainstream media hails quantum computers as significantly faster than current models. It turns out they're only fast in specific areas: cryptography, optimisation, simulation, and database searches. In cryptography, many algorithms are

safe, because factorising large prime numbers with classical computers takes far too long to be practical. Shor's quantum algorithm can do it in minutes. Optimisation and simulations can benefit from a quantum computer's ability to test many solutions at once.

Database searches are faster by a factor of four. And with speedier database searches, machine learning also becomes much faster.

The history of quantum computers begins with quantum physics. In 1900, Max Planck first proposed that light comes in discrete packets, called quanta. This discovery later led Einstein to show that Planck was right. When measuring the photoelectric effect, scientists could observe packet behavior. These two discoveries later led to quantum physics. Yet the deeper

scientists dived into the quantum nature of things, the harder it got to explain how it works. For quantum computing, the most interesting developments are entanglement and superposition.

Superposition is where a particle exists in many positions at the same time. Considering this, scientists concluded that a quantum computer should be possible to build. A quantum computer is one that can do many calculations per operation.

THE CAT IN THE BOX

The famous physicist Schrödinger created a thought experiment. In it, he describes a cat and a gas container inside a box. The gas will poison the cat after the radioactive decay of an atom that releases the gas. The process is random, so observers won't know if the cat is dead or alive until they open the box. In quantum physics, this means that the cat is both alive and dead before anyone observes it. In the case of the cat, this is absurd, but in quantum physics, it's normal. What Schrödinger was saying was that there must be another explanation – one as yet undiscovered.

Entanglement is where two particles can have intertwined states. This means that the state of one particle is always the opposite of the other, even when they are apart. In quantum computers, the software creates entanglement; a CNOT gate creates this state.

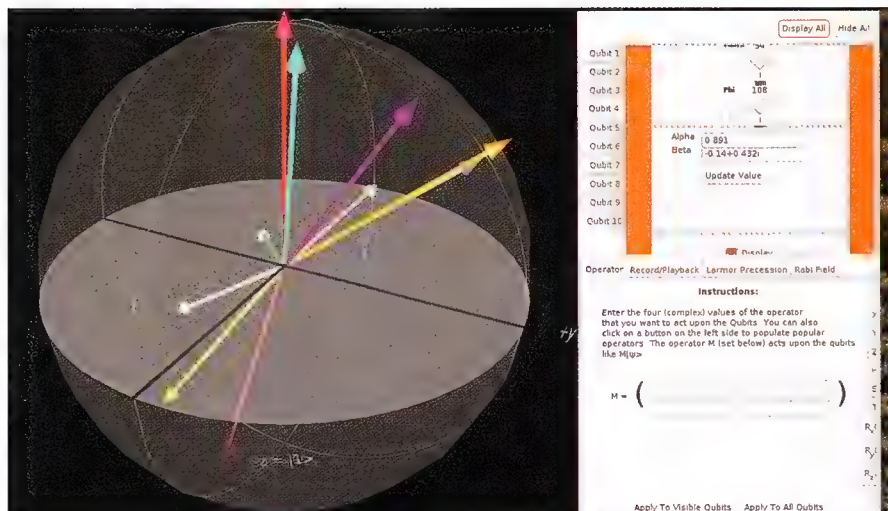
To make use of all the phenomena demonstrated in quantum physics, scientists needed a way to describe what happens on a small scale. To program a computer, it needs logical operations, or logical gates. Quantum gates and classical logic gates are the same only up to a point. Quantum gates add features for changing states and entanglement.

It took until the 1970s for the first attempt at a theory to use quantum effects for computers. Shannon information theory describes classical gates and other aspects of data processing. For quantum computers, this is insufficient, because it doesn't specifically describe quantum effects.

Quantum information theory was first tried in 1976. During the 1980s, scientists made more progress, in part thanks to quantum computing conferences organised by MIT and IBM. Other developments included quantum cryptography and the first universal quantum computer.

To use all the states of the particle you measure, programmers need a formal language. Quantum information theory needed to improve. The different gates are the foundation for such a scheme.

Keeping track of what the different



Programmers use the Bloch sphere to illustrate how quantum gates manipulate the qubits.

quantum states are is confusing. First of all, the way it works is counter-intuitive at best. Second, there are many different spin axes to keep track of. The system isn't complicated, but it involves atypical approaches that are tricky to grasp. To make sense of all the state transitions, physicists created the Bloch sphere.

Peter Shor discovered Shor's algorithm in 1994. This algorithm solves the problem of finding the prime factors of large numbers. The basis of all encryption is that you can't, in a reasonable time, solve this problem. Quantum computers may solve this problem in minutes. Interest in quantum computers subsequently sky-rocketed.

Shortly after Shor's discovery, Lov Grover invented the Grover algorithm. This is best known as the database search algorithm, but it's also useful for other tasks.

Through the coming decades, scientists invented new features.

Quantum error correction and fault-tolerant quantum computers were among the major ones. The first demonstration of a quantum computer took place in 1998. After this, development accelerated.

THE ION AGE

To date, there is a range of quantum computers in use. Researchers are using ion traps, light-based, and microwave-controlled Bose-Einstein condensates. These types need different control mechanisms. The ion traps use an electromagnetic field to trap the ions. Lasers create the field, keep the ion trapped, and "pump" the state of the electron of the ion. The electron will emit light only when the state matches the laser's frequency.

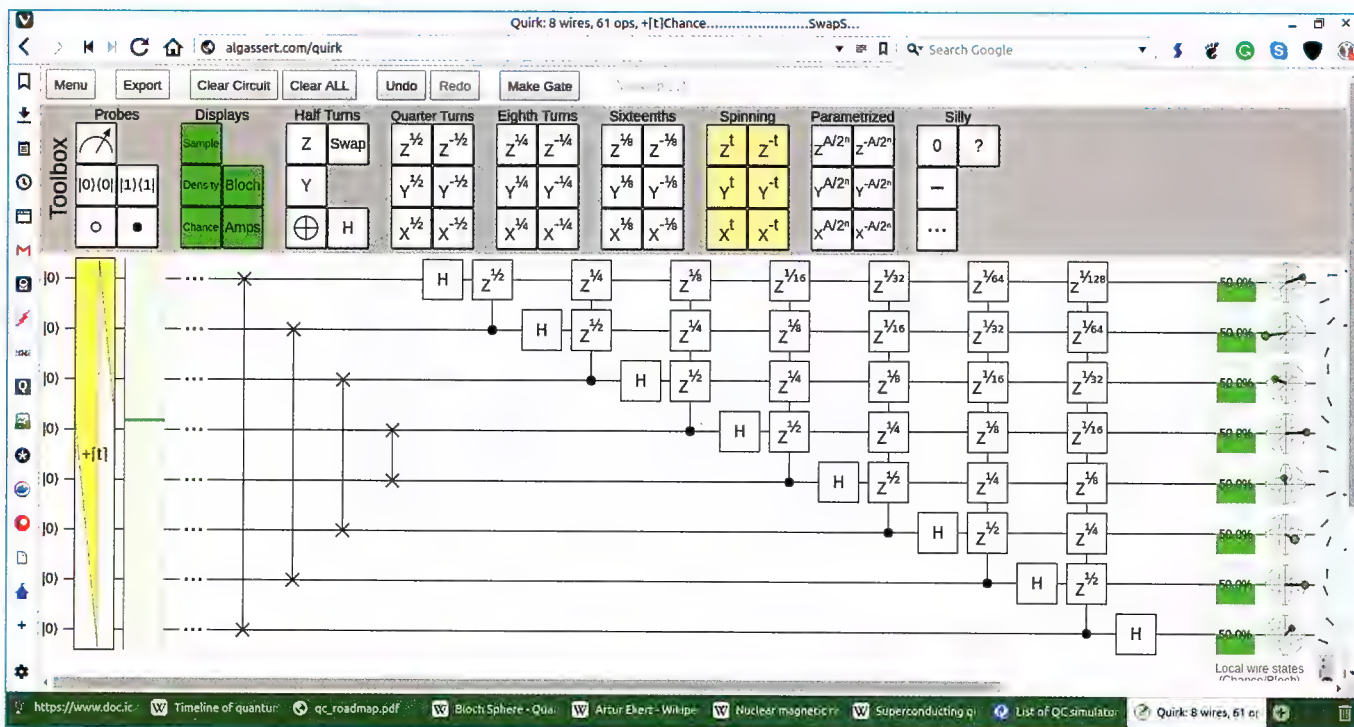
This is the logical 1 state, while the logical 0 state is the opposite. This makes it simple to measure, but achieving precision is still a challenge. Manufacturing is also expensive using current technologies. Meanwhile, a

Encryption may be at risk

One big question is whether encryption systems are at risk with quantum computers.

The major concern is the RSA encryption scheme. The scheme is secure because it relies on the condition that factoring a large number into its primes is too time-consuming. When trying to find the prime numbers, there are many strategies, so the simplest one is to guess and try. A trial and error approach isn't practical, though, since a 2,048-bit number has millions of solutions. Some strategies can reduce the number of possible solutions, but even the most powerful methods will take years or millions of years. With the right algorithms, a quantum computer could reduce that time to a practical level. Efforts are underway to create other algorithms that are not breakable this way.

While this is prudent, the risk that a quantum computer can do this within 15 years is low. Today's quantum computers are both small and hard to program. The frameworks available for programming are few and far between. As you can see in other parts of this article, you'll still be setting a few qubit states and twisting the states. Converting that to a fine-tuned encryption-cracker is, more than likely, a far-off prospect for now.



When starting out, programmers use a score, like a music score. The picture shows Quirk, an online simulator. The circuit is showing a Quantum Fourier transform.

Bose-Einstein condensate is a gas cooled to millikelvin temperatures. When the gas reaches this temperature, all electrons take the same quantum state. Uses for this solution are, so far, limited to simulators – any actual computers are pipe dreams.

The interesting types are the Josephson junction types; these actually are running in practical setups. IBM's versions are even available for anyone who registers on the Q Experience web page.

The D-Wave machine uses Josephson junctions. These are superconducting niobium and aluminum-oxide gates. At temperatures near absolute zero, a sensitive magnetometer measures their magnetic properties. The values show the quantum state of the junction, making the circuit a qubit. The principle this computer uses is quantum annealing.

IBM uses Nuclear Magnetic Resonance (NMR). The qubit is still a Josephson gate. That solution uses microwave transmitters to interact with the qubit.

The difference between the two is that the IBM solution controls qubits to a higher degree. This has made it easier for Canadian company D-Wave to manufacture bigger chips. At the same time, this limits D-Wave to fewer applications. For example, an annealing system can't run Shor's algorithm or Grover's. It's useful for optimisation and machine learning – no wonder Google already has one of its own D-Wave quantum computers.

MORE IS LESS WORK

As mentioned, the algorithms in quantum computers are different. To explain what the difference is, you must bear in mind the physics involved. You probably already know that a conventional computer uses gates. The system uses Boolean logic to create the algorithms for calculating everything. The most important aspect of this is that it's deterministic, so we only deal in certainties. The answer is either yes or no – at least on the circuit level.

In contrast, quantum computing involves all answers having a probability attached to them. No answer is certain – rather, it is

probabilistic. For this to be efficient, the algorithms must be adapted.

Quantum gates have an effect on one or several qubits at a time. When you measure qubits, the system usually does a complete analysis of the entire system. So, if you're searching for one qubit, that one will stick out like a sore thumb in one operation. Note that one operation is made up of many shots of the same gates. This is one of the reasons why quantum computers are faster than a conventional one.

The most common scenario is to find the special number of many, such as a database search. The other most cited case is for breaking encryption. Using Shor's algorithm, you measure the

Quantum simulators

To help understand how quantum computers work, there are several simulators.

There's no way that you can simulate one efficiently, but if you want to understand the underlying principles, many of these are excellent. The first one worth exploring is a Bloch sphere simulator. Without having at least a rudimentary understanding of the Bloch sphere, you'll have trouble understanding what the gates do. Learn more about it at <http://eecs.ceas.uc.edu/~cahaymm/blochsphere>.

There are many more simulators – the majority are the results of PhD thesis work. For that reason, most of them are not active, only good starts. The few mentioned here are useful for self-education.

The JQuantum simulator looks and behaves like a quantum score. Using it is a little cumbersome, but if you're practicing this while reading a textbook, then it becomes usable and clear. It also supports your own functions.

This is useful when you follow a course and want to test it on your own. The only other way to do that is to use your IDE and write a quantum program yourself. If you have Python experience, this is doable, but be warned – the simulation won't look pretty.

Toolkits from the big guys

To program yourself requires the standard called OpenQASM.

This is the basis for all development kits. Many groups have developed toolkits using this standard. The best-known ones are from IBM, D-Wave, and Microsoft.

IBM decided to use Python to create Qiskit, and you can download this kit from Github. It also has many sources and demonstration collections available. You can learn all about the current development state from there.

In both Eclipse and Netbeans, all you need to do is import the code into a project and explore. Don't forget to install Python 3.5 or higher before you try to compile. IBM's QE has these examples in its Python toolkit. When you have the sources installed, you can only run simulations on your own computer. If you want to run on a real quantum computer, you need to get an account on the IBM Q Experience. The setup is simple: All you need to do is open an account and get your API token from your account. Then copy it into the "Qconfig.py" file of the project you're currently working on.

There's a credit system for using the real machines, so simulate until you're certain that you've got it right. If you're really clever, you may be able to gain expertise level. In that case, you can obtain more units to run experiments.

If you're using Visual Studio, you can download the Qvis file and add the extension. You still need Python support, though.

solution by the action of the gates. The gates run the input a fixed number of times before finding the answer. That number doesn't change when the input is a higher number. A classical computer forces you to test all possible answers. This means that when the number reaches 2,048 you are facing a potential million years to solve it. More numbers mean an exponential workload increase. The effort to solve the problem does not increase in a quantum computer.

LET'S HAVE A BLOCH PARTY

Once you know how many states and transitions you have in each qubit, it's time to code. Not so fast, though – there's a visual way to describe the gates. The Bloch sphere is the basis for all gates. The graph looks like a music score, so it's called a quantum score. It looks a bit different depending on the platform, but in general, the strings across are qubits. When you want to change the state of a qubit, you place a gate on the string. To create entanglement between two qubits, you drop the gate on one string and connect it to the other.

To describe the quantum state of a particle, you use spin, like a spinning ball. More precisely, the angle the "ball" spins. Even though there are no balls in the classical sense, the math describes it well. When the equipment measures an electron, it's in spin up or spin down in one axis. The system can only measure in one dimension at a time. The three are x, y, and z. If you measure x, you lose all information about the spin state on the z and y axes. When you describe the quantum state, you use an imaginary arrow in the Bloch sphere.

The top of the sphere represents the

qubit's logical 0 and the bottom is logical 1. These are the only two states that the system can measure with 100 percent certainty. To get a result in a quantum computer, you make many "shots" and get the most probable answer.

A matrix contains co-ordinates that show the arrow's angle. The length of the arrow is always 1. The values we use to calculate the probability describe the components of the axes for the arrow. The Bloch sphere rules the gates and their naming.

The available gates depend on the application and type of quantum

computer. But the following are the common ones. The Pauli X gate rotates the state around the x-axis, changing the value of z. This gate is also a bit-flip gate. The Pauli Y gate rotates around the y-axis, changing the x value and the z value. This gate is a bit-flip and a phase-flip gate.

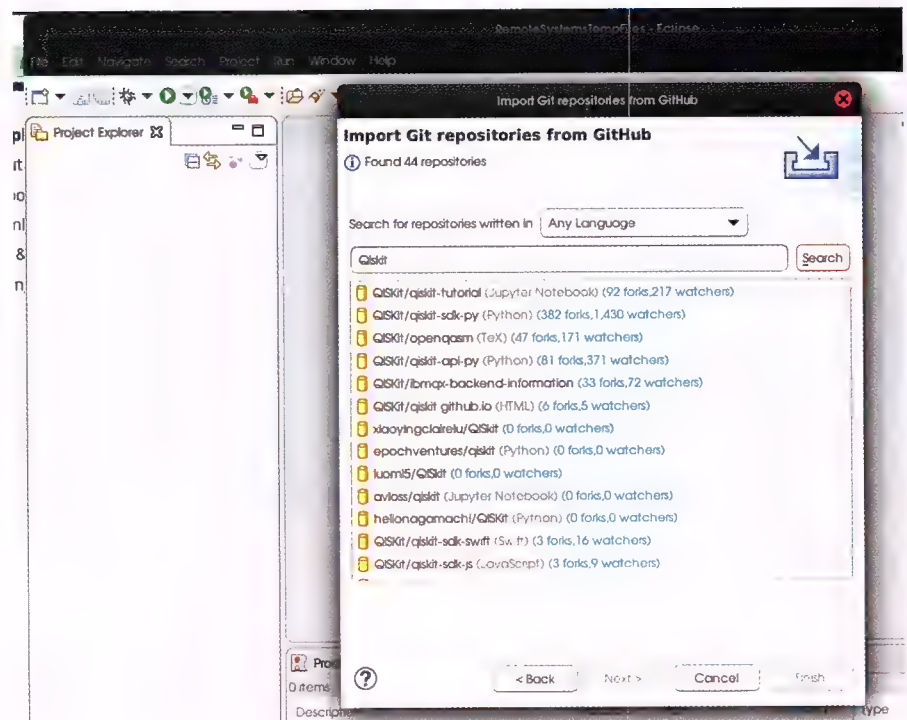
So far, the gates only flip the bits and phases. These don't deal with superposition or entanglement. The Hadamard gate puts the qubit in a superposition. To make that clear, the qubit will have a 50 percent chance of being 0 or 1, flipping between X and Z.

It will act like a dice, only using two in a row will always give the starting value. More gates that extend the Hadamard gate are S and its transformed conjugate.

To use entanglement, you use a CNOT gate, usually depicted with a plus sign in a circle and a line down to another qubit. The gate flips the target qubit when the control is 1.

Those are the basic gates you'll encounter as you start out. On the IBM Q Experience, you have the chance to also create subroutines. A better idea, though, is to use a development kit. There are many available, and you can extend your IDE with them. Eclipse, Netbeans, and Visual Studio have modules. They use several languages. The programming tools for Python, for example, are available from IBM. Note that the routines prepare scripts for the quantum computer – it doesn't run Python on it.

So get cracking! You won't create much at first, but we guarantee you will have a lot of fun. ■



Here, we're employing Eclipse to develop our own quantum computing programs. Note that this particular toolkit is using Python as the supporting programming language.

Games for 2019

From heavy gunfire to forest spirits, Ian Evenden delivers his top tips for gaming in 2019.

Sequels and remakes, sequels and remakes. It's been a criticism of the games industry for some time that it's averse to taking a risk on something new, more content to rake over the past, and present the familiar and "safe." This has been particularly true ever since the idea of the "HD remaster" came into being, with old games being polished up for modern graphical standards – to

varying degrees of success – before being set before consumers as something new.

There is innovation – if you know where to look. The coming year sees a raft of Japanese games arrive on PC, the sort of thing that once would have stayed on PlayStation, while the unstoppable march of *Warhammer 40K* continues, and Tom Clancy is still producing games despite being dead for five years.

The PC is in a strong place as a games machine – the consoles look exhausted as they gear up for another generational leap – and it's the place to come to find the most spectacular graphics and the cleverest use of AI, as this brief rundown of games to look out for in 2019 shows. There are a few sequels and remakes, too, though.



Rage 2

TBC 2019

The sequel to id Software's post-apocalyptic FPS moves to Avalanche, home of *Just Cause*, where it picks up an open-world environment and a heavy nod to *Fury Road*. Once again, you're shooting mutants and driving messed-up vehicles, as well as lopping off heads with a razor-sharp boomerang, but this time it's using actual colors, rather than gray and brown.

■ Publisher: Bethesda

■ Developer: Avalanche Studios



Dirt Rally 2

02/26/19

The official game of the FIA World Rallycross Championship, *Dirt Rally 2* will take you to six rally locations around the world. The *Dirt* games have always been fun – there's a primal thrill in hurling a howling machine down muddy tracks and up gravelly mountains – and there's no reason to think this will be any different.

■ Publisher: Codemasters

■ Developer: Codemasters



Trials Rising

02/12/19

This ragdoll physics bike racer is poised to smash its way through unconvincing scenery following its beta at the end of 2018, bringing a new world-tour backdrop that plots courses around landmarks such as the Eiffel Tower. A new co-op mode will see two players control a single bike – a recipe for disaster if we ever heard one.

■ Publisher: Ubisoft ■ Developer: RedLynx/Ubisoft Kiev

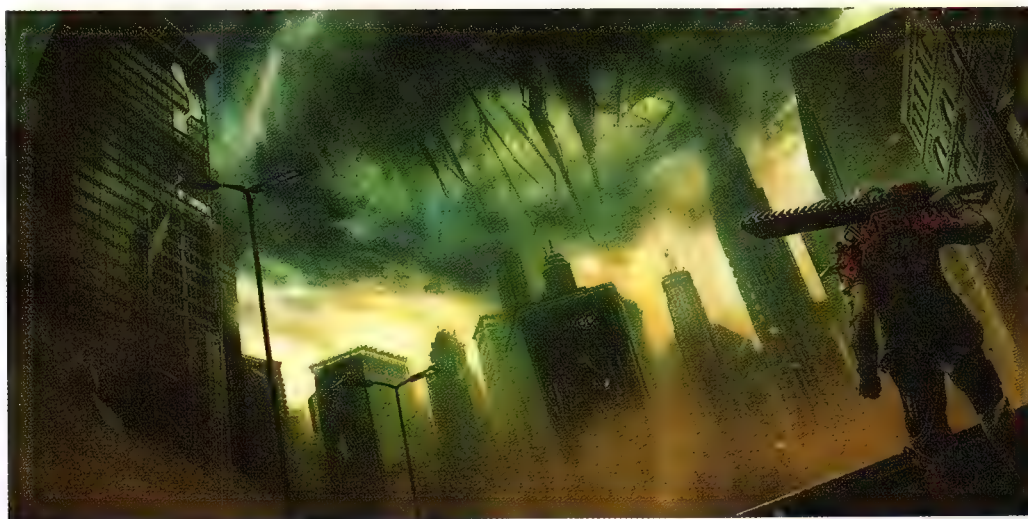


Crackdown 3

02/15/19

The Agency, a group of superpowered madmen, who've been known to drive jeeps straight up vertical buildings and blow the heads off hundreds of goons, is called into action after a terror attack takes out the power all around the world. We reckon we know what happens next, and it's not going to involve wiring puzzles.

■ Publisher: Microsoft ■ Developer: Sumo Digital



The Surge 2

TBC 2019

A sci-fi take on the *Souls* games was the USP of the original release, and while *The Surge* didn't quite get the acclaim that FromSoftware's series has, it was definitely worth picking up for a sequel. An open-world action RPG in which you fight robots – you can expect oil to be splattered everywhere.

■ Publisher: Focus Home Interactive
■ Developer: Deck 13



Warcraft III: Reforged

TBC 2019

A remake of the 2002 RTS original made with the events of *WoW* in mind, it looks stunning. Hopefully, the retconned events and rebalanced gameplay will be as much of a time sink as first time. The original will get a patch, too, and owners will be able to play against *Reforgerd* players.

■ Publisher: Blizzard Entertainment
■ Developer: Blizzard Entertainment

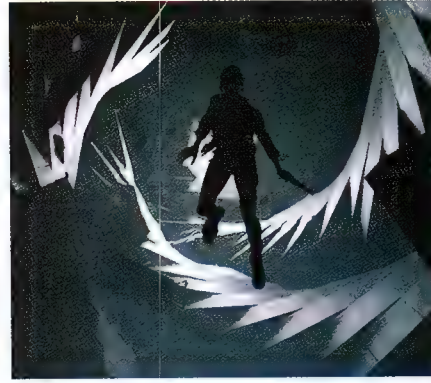


The Settlers

FALL 2019

German dev Blue Byte has picked up the reins of its venerable RTS series and completely updated it for modern PCs and Ubisoft's Snowdrop engine, so it's looking quite splendid. And if you're hot for some medieval town-building, there's an updated version of the original game on uPlay, too.

■ Publisher: Ubisoft
■ Developer: Blue Byte



Control

TBC 2019

Alan Wake dev Remedy is behind this third-person adventure in which a psychic, perhaps supernatural, woman fights her way through a brutalist skyscraper with a shape-changing pistol. After *Alan Wake's American Nightmare*, we suppose this was inevitable.

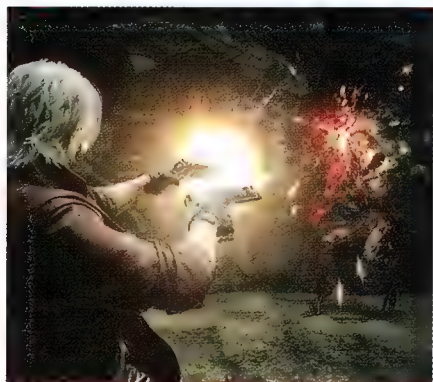
■ Publisher: 505 Games
■ Developer: Remedy Entertainment

Sekiro: Shadows Die Twice

03/22/19

Coming from FromSoftware, the studio behind *Dark Souls*, *Armored Core*, and *Bloodborne*, we're not expecting this to be an easy game. Set in Sengoku Japan, and following a mysterious one-armed warrior, Sekiro eschews the usual health bars in favor of one-hit kills, but you must knock your opponent off balance first in a graceful duel.

■ Publisher: Pub Activision
■ Developer: FromSoftware



Devil May Cry 5

03/08/19

Not a traditional PC franchise, but the boundaries are dissolving now there's X86 at the heart of consoles, too. This one's about demon hunters, one of whom uses his motorbike and hat as weapons. There are also a lot of guns and swords, occasionally a massive fleshy scythe, and their arms come off. Very confusing, but a lot of fun, and spectacular in motion.

■ Publisher: Capcom
■ Developer: Capcom



Anno 1800

FEBRUARY 2019

The *Anno* universe hits the industrial revolution, and sees you use the power of metal and steam engines to build a rural community into an industrialized city. The series has melded elements of grand strategy, such as diplomacy and warfare, on to its city-building core, so seeing what it can do with this tumultuous time in history will be extremely interesting.

■ Publisher: Ubisoft
■ Developer: Blue Byte



Phoenix Point

JUNE 2019

From one of the men behind the original *X-COM* (that's 1994, not 2012) this is a spiritual successor to the series – so we know how it's going to play out. Turn-based combat, an alien invasion, and a resistance cell bravely battling both monsters and resource management trying to take the bad guys down. Frankly, we can't wait.

■ Publisher: TBC
■ Developer: Snapshot Games

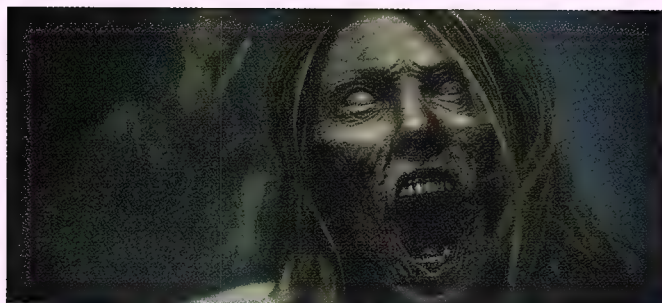


Age of Wonders: Planetfall

TBC 2019

Turn-based empire building in a sci-fi setting with multiple paths to victory sounds great, and when it comes from the dev behind *Age of Wonders* dating back to 1999, we like it even more. Bought by Paradox last year, the Dutch studio should now have the backing and resources it needs to knock this into orbit.

■ » Publisher: Paradox Interactive
■ » Developer: Triumph Studios



Resident Evil 2

01/25/19

A remake of the 1998 PlayStation classic, this has learned from 20 years of game releases, and implemented things such as a checkpoint save system, controls that don't make you want to scream, and a proper PC release. Otherwise, it's exactly what you'd expect, as an army of the undead is fought off by two characters using guns, grenade launchers, and lockpicks.

■ Publisher: Capcom ■ Developer: Capcom



Left Alive

03/05/19

A shooter set in the *Front Mission* universe – that means enormous stompy robots – *Left Alive* spins a tale of honor, revenge, and despair. And huge metal men. We'd be disappointed if you didn't get to blow at least one up, but the trailers so far have been heavy on characterisation and Metal Gear-like tactical shooting.

■ Publisher: Square Enix

■ Developer: Square Enix



Skull & Bones

TBC 2019

Open-world tactical action tends to bring up images of gruff men in black with guns – but this one is about pirates. The characters may still be gruff, but there's a chance of a shanty as you either pursue the single-player campaign or team up with five others to battle against other ships.

■ Publisher: Ubisoft

■ Developer: Ubisoft Singapore



Tom Clancy's The Division 2

03/15/19

Another persistent-world multiplayer from Ubisoft, this time in Washington DC in summer. The viral apocalypse still took place, but you have new weapons and skills to deal with the enemies it caused.

■ Publisher: Ubisoft

■ Developer: Massive Entertainment



Ori and the Will of the Wisps

TBC 2019

Ori and the Blind Forest was a charming hit in 2015, and this promises more of the same. A guardian spirit moves between platforms and solves puzzles, while getting stronger and unlocking new areas.

■ Publisher: Microsoft

■ Developer: Moon Studios



Life is Strange II

EPISODE 1 OUT NOW, OTHERS TBC

Taking its structure from road movies, Sean is on the run from the police with his brother – who has mysterious powers – after their father was killed in what appears to be a supernatural incident.

■ Publisher: Square Enix

■ Developer: Dontnod Entertainment



Wolfenstein: Youngblood

TBC 2019

MachineGames clearly wanted a change; this co-op game is set in the 1980s, and stars BJ's twin girls. The Nazis are still in power in some places, and need to be taken out with extreme prejudice. Goody!

- Publisher: Bethesda
- Developer: MachineGames

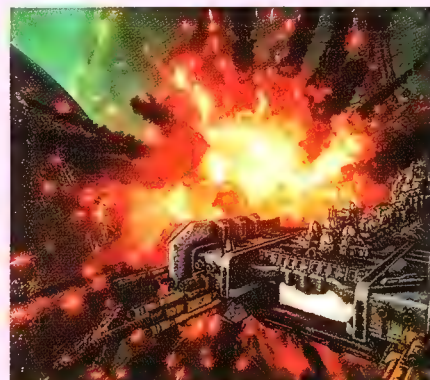


A Plague Tale: Innocence

TBC 2019

Children struggling to survive the Hundred Years War is a jolly premise. Plus, they're stalked by hungry rats, which they must drive off with fire or lure into the path of knights. One to watch. From a distance.

- Publisher: Focus Home Interactive
- Developer: Asobo Studio



Battlefleet Gothic: Armada 2

01/24/19

Smash huge spaceships into even bigger biological terrors in this *Warhammer 40,000* strategy. Twelve factions will be playable at launch, and ships eating other ships aren't out of the question.

- Publisher: Focus Home Interactive
- Developer: Tindalos Interactive

Gears 5

TBC 2019

Though no longer officially "Of War," the Gears are still fighting, now in a quest to discover the origin of the Locust Horde and, presumably, carve it in half with a chainsaw. JD Fenix, the protagonist of gaming's least subtle third-person blaster, returns, as does his dad Marcus, who's still voiced by Bender.

- Publisher: Microsoft
- Developer: The Coalition



Shenmue III

08/27/19

Really? Yes, it seems it actually will come out. This "for the fans, by the fans" is actually by series creator Yu Suzuki, and sees martial artist Ryo journey into the Japanese mountains, where he meets a mysterious girl and a new enemy.

- Publisher: Deep Silver
- Developer: Ys Net/Neilo



Psychonauts 2

04/19/19

Here's something we don't see much of: a platform game. This crowdfunded sequel sees Raz and his psychic spies explore the mental landscapes of in-game characters, which become the game's levels, to be traversed using a range of powers.

- Publisher: Majesco Entertainment
- Developer: Double Fine



Tropico 6

JANUARY 2019

The bonkers Caribbean dictator sim is back for another grasp at power, bringing large archipelagos to the series. You also send agents to other countries to steal monuments, make promises you can't keep, and gold-plate your palace.

- Publisher: Gathering of Developers
- Developer: PopTop Software



Ace Combat 7: Skies Unknown

02/01/19

In the absence of Top Gun 2, this will have to do. Ace Combat is a series about hurling millions of dollars of jet around the skies and not caring too much. It's definitely not a simulation, because we're fairly sure the USAF doesn't do this many loops in normal operations, but it is fast and spectacular, with lots of gratifying explosions.

■ Publisher: Bandai Namco
■ Developer: Bandai Namco



Metro Exodus

02/22/19

You know when everyone tries to get off the subway at once, only with even more guns? The third *Metro* game starts off in a harsh, post-apocalyptic winter, before sending protagonist Artyom out of the city and across an entire continent. No doubt this break from the claustrophobic norm will be interrupted by bitter fighting and mutated creatures, as usual.

■ Publisher: Deep Silver ■ Developer: 4A Games



Imperator: Rome

TBC 2019

More strategy from Paradox, this time with a sequel to 2008's *Europa Universalis: Rome*, and covering the establishment of the Roman Empire 2,500 years ago. While most of the game will see you battling on a grand scale, there will also be character management, in the style of *Crusader Kings II*.

■ Publisher: Paradox Interactive
■ Developer: Paradox Development Studio



Total War: Three Kingdoms

03/07/19

Creative Assembly takes its historical battle series to China, where 11 factions are fighting it out to unify the country into the behemoth we know today. Romance mode, based on the classic novel *Romance of the Three Kingdoms*, will gift generals with superhuman powers, while in other modes those generals will form social connections and relationships. Before spilling lots of blood, of course.

■ Publisher: Sega
■ Developer: Creative Assembly



System News

The inevitable has finally happened, and Mark Williams is very happy to see Nvidia capitulate.

As has been the case every year for the past twenty years straight, the technology world gathers in Las Vegas to see what the biggest and best technology companies in the world have come up with at CES (the Consumer Electronics Show). The show, as the name suggests is consumer oriented, as opposed to a trade show like Taiwan's Computex, so you see a wide gamut of things, which this year ranged from laundry folding machines to RoboSharks, right through to the stuff we're more interested in: new PC tech.

There were of course the big players in PC chip making there, spruiking their latest wares. AMD was offering up everything from (essentially) a faster Vega 64 in the form of the Radeon VII ("Radeon Seven") to the new mobile Ryzen 3000 series, which are just Ryzen 2000 series that have finally made it into the laptop market. Two decent announcements, to be sure, but ultimately kind of dull in terms of pushing the envelope.

Where AMD did push the envelope is with what we've all been waiting for – a preview and some initial benchmarks for the Zen2 architecture that will power the Ryzen 3000 series desktop processors. With its sample benchmarking equal to Intel's current and extremely expensive i9-9900K, things are looking promising for AMD in 2019. With a launch time frame of mid-2019, this could well be the first time in history AMD has both a manufacturing and design lead over Intel. Something one would expect AMD to exploit in order to gain more market share this year.

Intel released some more details on its lower end SKUs for 9th gen Core

processors, which are just a stop gap until 10nm can be ramped up later this year at best and will bring with it a brand-new architecture philosophy.

Nvidia released the RTX 2060, a solid mid-tier card that'll work reasonably well with ray-tracing. It was expected and thus not so surprising when it launched. The large price increase over the previous GTX 1060, however, was surprising, and may well put off many customers.

Where Nvidia really caught everyone off guard was with the announcement that GTX 1000 and RTX 2000 series cards will support VESA's Adaptive Sync (AKA FreeSync). This is something they realistically should have adopted and supported from the outset, but as Nvidia was the first to market with its own adaptive sync technology, G-Sync, it stubbornly stuck to its proprietary tech in the hopes of winning the war against the license free and open standard VESA had set out, despite being included in the DisplayPort 1.2a spec for quite some time.

As Nvidia wasn't sharing or even licensing its syncing tech to other GPU companies (AMD and Intel) it essentially dug its own grave on the uptake front. With AMD backing the VESA standard and marketing it as FreeSync and Intel announcing it will also start supporting Adaptive Sync soon too, plus with high overhead costs for G-Sync supporting monitors, Nvidia has been backed into a corner for a while now. Proprietary tech only goes so far when you don't have a monopoly in a market.

Nvidia supporting adaptive sync (FreeSync) monitors is admission that its stubbornness to not play nice with the rest of the industry is now

SHOP TALK

What products or technologies from CES drew your attention, both for the future of tech but also for your customers?

John, Ti Computers

"We found the compatibility with adaptive sync by Nvidia to be the most interesting and most beneficial to our customers. Not only that brings to the table a much clear guidelines to the results to be expected by adopting the various grades of G-Sync, it also opens the door for us to offer some more value driven gaming combos to our customers alongside the new GPUs. Apart from that, the new Ryzen 3 also sound quite promising. This is the first time in over a decade that AMD really overtakes Intel in terms of new technologies while offering performance that can go head to head with Intel in the same generation. 2019 is definitely going to be one interesting year ahead with new options we can offer to our customers."

backfiring. With any luck we'll see the removal of the G-Sync chip requirement in monitors and thus the \$100+ "G-Sync tax". Then we can finally buy monitors that will adaptively sync frames no matter what GPU you're using and save some money along the

Market Snapshot

A sampling of PC systems available this month.



Aftershock PC Hypergate Mini

\$2,065 [TINYURL.COM/APC465-AFTER](https://tinyurl.com/APC465-AFTER)

The recommended spec for this little beastly makes for quite a magnificent gaming rig. Granted, the image shown is the system with the optional \$1,000 custom water loop installed, but even with the regular HSF cooling, this system is a very tasty bit of kit. Neither the motherboard or CPU happen to be overclocker friendly, if that's important to you. Ignoring that, this CPU and GPU pairing is very nice for high end 1080p or mid-tier 1440p gaming performance. Our only gripe would be the 8GB of system RAM. Power users might want to opt for 16GB at checkout for an extra \$120. A little pricey for the kit but given the build quality and customer care it's acceptable.

KEY SPECS: CPU: Intel Core i5-8500; Cooler: Aftershock F10 Premium HSF; Motherboard: H310M based with AC Wi-Fi; Graphics: Nvidia RTX 2060 6GB GDDR6; Memory: 8GB DDR4 2666MHz; Storage: 512GB M.2 SSD SATA, 1TB Toshiba HDD; Power Supply: Unknown; Case: NZXT H200i

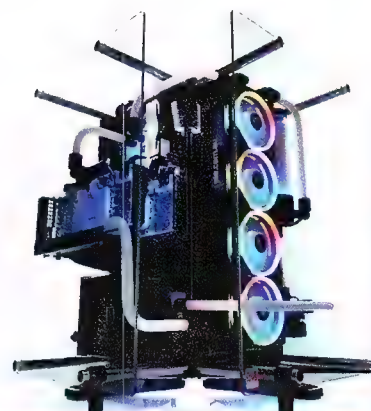


Scorptec Meshify RTX 2070 Gaming PC

\$2,349 [TINYURL.COM/APC465-SCORP](https://tinyurl.com/APC465-SCORP)

What a difference an extra few hundred dollars make. Relative to the Hypergate Mini system, this packs more CPU and GPU grunt, comfortably capable of 144Hz 1080p or high setting 1440p gaming. This has a more comfortable 16GB of system RAM however system storage seems to have taken a little bit of a hit as a result, with just 256GB of SSD storage, but it is NVMe though, so it's super speedy. The 550W PSU feels a little bit anaemic. It'll be fine for this configuration at stock but if you plan to overclock you may run into power shortage issues. Beware.

KEY SPECS: CPU: AMD Ryzen 7 2700; Cooler: OEM; Motherboard: Asus ROG Strix B450-F; Graphics: Asus Turbo GeForce RTX 2070 8GB; Memory: Corsair Vengeance LPX 16GB 2666MHz DDR4; Storage: Samsung 970 EVO 250GB M.2 SSD, Seagate BarraCuda 2TB HDD; Power Supply: Corsair CX550M 550W; Case: Fractal Design Meshify Black ATX



PLE Computers OMG Custom Watercooled Gaming PC

\$9,471 [INYURL.COM/APC465-OMG](https://tinyurl.com/APC465-OMG)

Feel like dropping ten grand on a gaming rig of the gods? This half fulfils that dream. It costs a motza and has the best CPU and GPUs available, but the use of SLI these days is very tenuous, with Nvidia not being able to make up its mind as to whether it supports it anymore now that DX12's explicit multi-adapter is a possibility. Driver support and games that support SLI are extremely hit and miss, currently. More miss. Going with a single graphics card and improving the rather lean single 500GB SSD to something like an Intel Optane drive truly would've made this system OMG worthy.

KEY SPECS: CPU: Intel Core i9 9900K 3.6GHz; Cooler: PLE Custom Watercooling CPU + 2 GPU (Rigid Tubing); Motherboard: Gigabyte Z390 Aorus Master; Graphics: 2x Gigabyte GeForce RTX2080Ti WINDFORCE OC 11GB GDDR6; Memory: GeIL Super Luce RGB Sync C16 3000MHz DDR4 32GB; Storage: WD Black 500GB 3D NAND NVMe M.2 SSD; Power Supply: FSP Hydro PTM+ RGB 1200W; Case: Thermaltake Core P90 Tempered Glass Edition

TI Computers Best Budget Gaming PC

\$699 [TINYURL.COM/APC465-TI](https://tinyurl.com/APC465-TI)

Calling this system a gaming PC is a little bit of a stretch considering the most important part for actual gaming, being the GPU, is only an integrated solution. However, as far as integrated graphics processors go, this is one of the most powerful available. It's only suitable for 1080p at low details in 3D

games but if you're just a casual gamer it could be perfect. The rest of the system admirably reflects the low-cost price. One thing we do like is the large SSD only storage. In a segment where hard drives can make a lot of sense, it's nice to see.

KEY SPECS: CPU: AMD Ryzen3 2200G; Cooler: OEM; Motherboard: Asus A320M-K; Graphics: Onboard (Vega 8); Memory: Kingston 2400MHz DDR4 8GB; Storage: 480GB Kingston SSD; Power Supply: Cooler Master 500W; Case: Cooler Master MasterBox Lite 3



PC blueprints

The APC team's picks for a part-by-part perfect PC build to suit your budget.



PARTS LIST

PART		PRICE
CASE	BITFENIX NOVA TG	\$69
PSU	450W CORSAIR CX450	\$69
MOBO	ASROCK AB320M-DGS	\$78
CPU	AMD RYZEN 5 2600 NEW	\$259
GPU	GIGABYTE GEFORCE GTX 1060 3GB NEW	\$339
RAM	8GB (2X 4GB) TEAM T-FORCE DARK @ 3,000MHZ NEW	\$109
SSD	120GB CRUCIAL BX500 SSD NEW	\$39
HDD	1TB WD BLUE WD10EZEX NEW	\$59
OS	UBUNTU DESKTOP LINUX 18.04 LTS 64-BIT	\$0
APPROXIMATE PRICE:		\$1,021

We've taken a significant hit on the budget build this issue, but not without gain. We've managed to switch out that aged GTX 1050 Ti for our favorite GPU of the last two years, the GTX 1060 3GB — it's a budget 1080p killing machine. Yes, perhaps the 3GB of VRAM isn't as future-proof as we'd like, especially in the bigger AAA memory-hogging titles, but it's difficult to argue with how much better value this thing is over its 1050 Ti sibling. For \$100 more, you get 50 percent more CUDA cores than the Ti, plus significantly higher boost clocks and memory clocks. We've also plumped up some more cash to upgrade the Ryzen 3 1200 to the Ryzen 5 2600, a six-core 3.9GHz processor. This effectively gives us an additional eight threads to play with, and an impressive 0.5GHz increase to the boost clock, along with all the memory latency enhancements Zen+ offers up.



PARTS LIST

PART		PRICE
CASE	FRACTAL DESIGN MESHIFY C	\$129
PSU	550W EVGA SUPERNOVA 550 G2 80+ GOLD NEW	\$155
MOBO	ASUS ROG STRIX B450-F GAMING	\$209
CPU	AMD RYZEN 7 2700	\$369
COOLER	CORSAIR HYDRO H100I PRO 240MM RGB AIO	\$169
GPU	ASUS GEFORCE GTX 1070 DUAL NEW	\$539
RAM	16GB (2X 8GB) TEAM T-FORCE @ 3,000MHZ NEW	\$209
SSD	250GB SAMSUNG 970 EVO M.2 PCIE SSD	\$135
HDD	1TB WD BLUE WD10EZEX NEW	\$359
OS	WINDOWS 10 HOME 64-BIT OEM	\$140
APPROXIMATE PRICE:		\$2,413

Not much change to our mid-range build. We've been able to keep the price to \$2,400 or so, but the great savings we managed to secure last issue on our GTX 1070 Ti are no longer available. That's a shame, as those GPUs essentially act as a slightly nerfed GTX 1080, but for about \$200 less usually. We'll keep an eye on that, as we expect it might be foreshadowing a GPU release. Yes, we're talking the RTX 2060. If it's not as powerful as a GTX 1070 Ti, we'll be highly surprised. Hopefully, it will be priced accordingly, and we can slot it straight into our mid-range GPU slot. In a few months (with the advent of multiple QLC drives), it might be time to swap out that hard drive for something a bit more flashy. Samsung is about to drop some seriously cheap 1TB drives, so we're holding out on that, too.



UPGRADE OF THE MONTH
1TB Samsung 860 Evo
\$235, WWW.SAMSUNG.COM

Nothing says enjoyment quite like instantaneous load times. Samsung's 860 Evo is exceptionally good value for money now. You can currently get the 1TB variant for a little under \$240, which is just awesome. A year or two back, this thing would have set you back near enough \$400. The margin between hard drives and flash seems to be shrinking, something we thought would never happen, but given the way things are developing, old-school hard drives may very well be on the way out.

There are a few other options out there for solid-state storage at this capacity and this price point, but with a five-year warranty and some impressive performance, there's very little reason not to go with Samsung right now.

"Threadripper, packing a full-sized CPU block, and enough grunt to tackle even the most heady of overlocks on our 2950X, no sweat. She's a beast."

Wow, we've saved \$776, and are only a nose over \$4K. This turns into a bit of a contest for us each issue, trying to spec the right parts, with the right performance, at the right price. We've made some substantial changes this time. The motherboard's been switched to Asrock's X399 Phantom Gaming 6, thanks to an impressive \$114 saving compared to last issue. We've also decided to err on the side of caution for cooling, and have gone for a full-sized Noctua air tower. The NH-U14S is specifically designed for Threadripper, packing a full-sized CPU block, and enough grunt to tackle even the most heady of overlocks on our 2950X, no sweat. She's a beast, and if you can get past the beige and brown, there's something quite attractive about it, especially if you can get the fans spinning at a low RPM.

Other than that, we've just played around with the models more than anything else. We've gone with Aus's RTX 2080 Dual, to save us \$150, and as with all build this month have found the best memory prices with Team T-Force.

The 2950X is a fine processor, and with 16 cores, it'll manage whatever you throw it at. If you game more, though, we recommend the 2920X instead; and if you need something more "enterprise," throw the memory out for some ECC stuff, and chuck in a 24-core or 36-core WX part instead.

PARTS LIST

PART		PRICE
CASE	NZXT H700I	\$170
PSU	CORSAIR RM750X WHITE 750W GOLD CERTIFIED	\$199
MOBO	ASROCK X399 PHANTOM GAMING 6 NEW	\$285
CPU	AMD THREADRIPPER 2950X	\$1,415
COOLER	NOCTUA NH-U14S TR4-SP3 AIR TOWER NEW	\$105
GPU	ASUS GEFORCE RTX 2080 DUAL FAN NEW	\$1,149
RAM	32GB (4X 8GB) TEAM T-FORCE DDR4 @ 3,000MHZ NEW	\$389
SSD	512GB SAMSUNG 970 PRO M.2 NVME	\$229
HDD	2X 2TB SEAGATE BARRACUDA ST2000DM008	\$89
OS	WINDOWS 10 HOME 64-BIT OEM	\$140
APPROXIMATE PRICE:		\$4,170



The multicore upgrade

When you change this much of your machine, is it still the same PC you started out with?

I didn't need a new PC, but I wanted one. My old gaming/image-editing build was constructed in 2012, and had grown organically over time. It was based around a Core i7-3770K, and had 32GB of DDR3 – absolute overkill, but I didn't foresee the effect cheaper SSDs would have, expecting huge amounts of RAM to become more common instead. Originally, it booted into Windows 8 from a Samsung 840 128GB SSD, with a 500GB WD Velociraptor for storage, plus a DVD drive, and a GeForce GTX 680 to push the pixels. All in a Cooler Master Silencio 450 case, with a Corsair 750W power supply.

A games PC is also a multi-purpose PC, and it handled everything I threw at it for years; my main PC for work and leisure. But the need to fiddle and improve is strong, and as new products hit the market and prices came down, I added

to it. Windows 10 came along. The Velociraptor was replaced with a 500GB SSD, then a second one was added, and a 2TB Seagate Barracuda hard drive. The DVD drive went in the cupboard. The Arctic Cooling Freezer 7 Pro cooler gave way to a Zalman closed-loop water cooler, and the GPU became a GTX 970, then a GeForce GTX 1070 Ti. After all this, it was still the same PC.

Replacing the motherboard and CPU, however, changes everything. The itch became so strong, it couldn't be ignored, and in a moment of madness, and with Cyber Monday in full swing, the six-year-old Core i7 was ousted in favor of a Threadripper 2950X, with new a mobo and RAM. Then power supply and case. And some SSDs. The question is, is it still the same PC now?

"It was based around a Core i7-3770K, and had 32GB of DDR3 – absolute overkill, but I didn't foresee the effect cheaper SSDs would have"

IN WITH THE NEW, AND THE OLD

At first, the 32-core 2990WX was considered, just because I like big numbers, but that chip's unique layout means it's extremely fast in the right application, but because the memory bandwidth is rationed out quite thinly, it suffers in many common tasks. The 2950X seemed like a much better bet, with the added bonus of being cheaper. RAM is Corsair, 32GB of the C16 LED DDR4 that lights up white, as it was keenly priced at the time.

Storage comes courtesy of M.2 drives – a Western Digital Blue 2TB SATA model for game downloads, and a 512GB Samsung 970 Evo as the boot drive, plus a 2TB spinner left over from the old build. Power is supplied by Corsair's modular 1,000W unit – this has the benefit of shutting off its fan when not under load, for extra quietness. We turned to Corsair again for CPU cooling, the Hydro Series H80i V2 fitting both the case and the chip, and its quiet fan and pump profiles help, too. The soundproofing on the Silencio case should add to this for a reasonably quiet build.

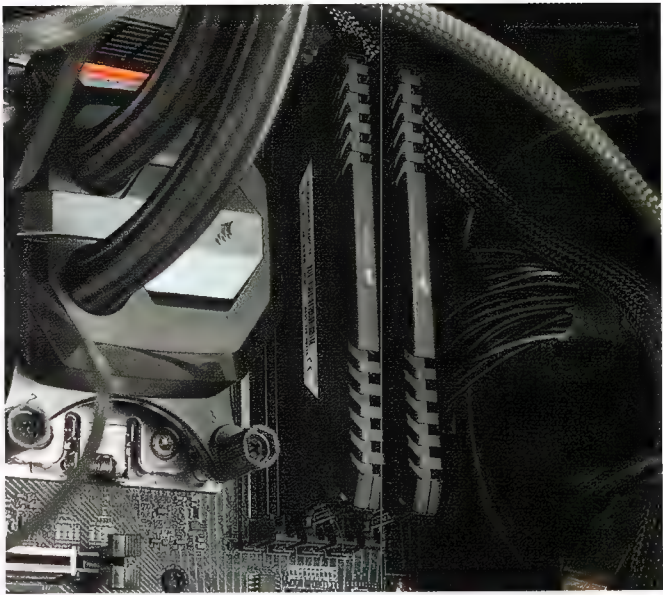
This PC is going to use a lot of USB devices, so I added an Icy Box 873 in one of the 5.25-inch bays, bringing with it a USB 3 reader for CompactFlash cards, as well as a couple more USB ports, including some type Cs, and a high-speed charging port.

The old case doesn't come with a window, so there's little point in glowing components. The MSI Aero 1070 Ti graphics card is plain black, but the MSI X399 Gaming Pro motherboard and the Corsair RAM do have lighting – we'll just turn it off.

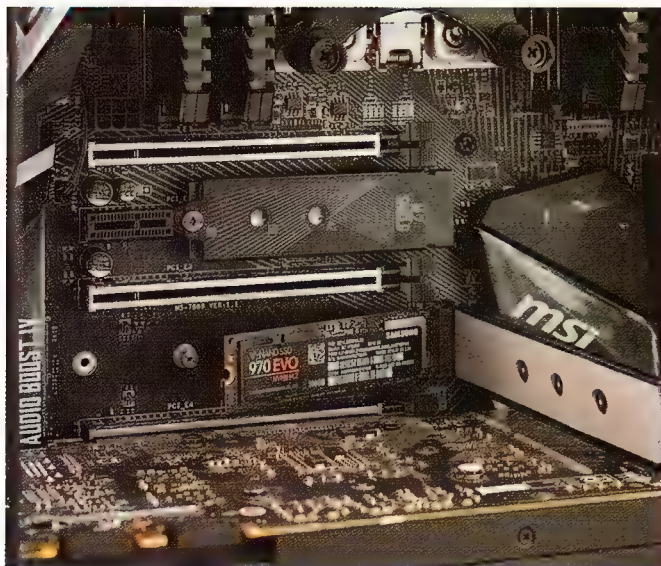


1 PSU WOES Using as much from the previous build as possible meant I had a case, graphics card, PSU, some storage, cables, and fans. Pulling the rest out really made me confront the decisions I'd made in 2012, and in subsequent upgrades. Why were there some screws loose in the bottom of the case? We'll never know. It became immediately apparent that the PSU would have to be replaced, because the X399 board requires two CPU power inputs, and the old Corsair unit only had one. A modular supply would help with the tidiness of the build, so one was ordered, with an eye on noise and tidiness, as well as power delivery.

PARTS LIST		
PART		STREET PRICE
CPU	AMD THREADRIPPER 2950X	\$1,415
MOTHERBOARD	MSI X399 GAMING PRO CARBON	\$519
RAM	CORSAIR VENGEANCE LED DDR4 RAM (4X 8GB)	\$549
PSU	CORSAIR RM1000X PSU	\$229
COOLER	CORSAIR HYDRO H80I V2	\$129
STORAGE 1	512GB 970 EVO	\$235
STORAGE 2	2TB WD BLUE SSD	\$569
CASE	PHANTEKS ENTHOO PRO M	\$149
TOTAL		\$3,794



2 RULE OF FOUR My failure to remember about Threadripper's quad-channel memory architecture saw the initial purchase of Corsair LPX low-profile RAM returned, because I'd bought 2x 16GB instead of 4x 8GB. Its replacement was Corsair Vengeance LED, as prices had changed in the interim, and it clicked easily into place around the socket. I'm old enough to have owned a slot-loading Pentium II, with a Klamath core rocking a whole 266MHz, but for a modern chip, the Threadripper seems excessively large. Once I work out how it slides into the raised arms of the socket, it slips in easily, the bundled Torx driver clamps it down, and suddenly the board is a lot heavier.



3 NVME VS. SATA

The use of one large M.2 drive was meant to streamline the build, but I'd made the silly assumption that they were all NVMe. This isn't true, and the drive I'd bought was plain old SATA III, no faster than my old SSDs. I still wanted the 2TB drive, however, so when a Samsung 970 Evo appeared in an online deal, I snapped it up. This became the boot drive and houses applications, with game libraries on the SATA drive, and the old 2TB hard drive for documents and photos. It looks neat, as the HDD is tucked away near the bottom of the case, and you can't see the M.2s at all under their heat spreaders.



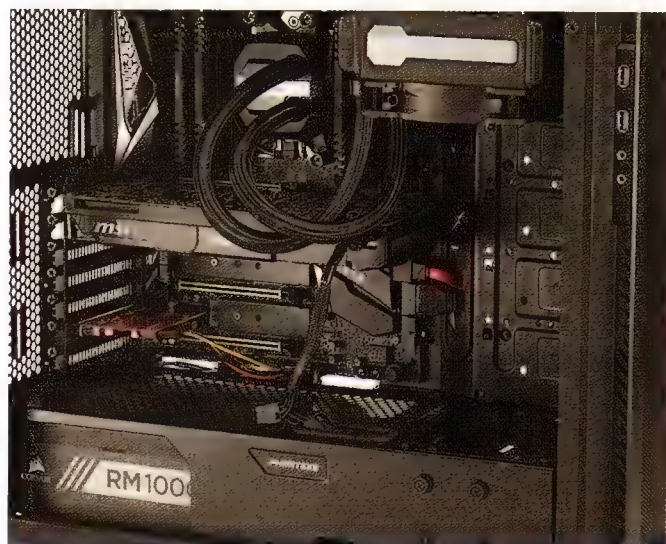
4 TOO TIGHT TO COOL

I should have noticed, but the CPU power connections and one stick of RAM are now right under the CPU cooler's radiator. There's also a weakness in the cooler/case combination – the screws don't quite line up at the back, so the PC ends up with the radiator and its fans hanging out the side of the case while I decide what to do. The Silencio case has almost no space behind the motherboard – it's full of soundproofing foam – so getting the side back on could be a challenge as power supply cables have become thicker over time. With all the power cables attached, I'm looking at the sort of power octopus I wanted to avoid. It boots up happily, though.



5 NEW CASE!

There's only one thing to do, and that's to get on the Internet and track down a reasonably priced new case. I choose a Phanteks Enthoo Pro M, as it's similar to my original, but more modern in every way. It also comes with a case window, something I've never had before. Moving everything over gives an opportunity to route the cables properly, and the additional room (along with the supplied cable ties) makes it a much easier job. The only issue I'm left with is that my cooler, being a single radiator with two fans, blocks the lone drive bay, so I can't fit my Icy Box. I'll either change the cooler later or find a way to use the Icy Box externally.



6 FINISHING TOUCHES

With everything hidden at the back, the view through the window now shows the mobo, GPU, cooler, and one power cable. The HDD is hidden at the bottom, and the M.2 drives are merged with the motherboard. Including Velcro straps and cable ties in the box was a nice touch from Phanteks, up there with the Torx driver bundled with the Threadripper itself. The new case is an inch or so wider than my old one, which means it won't fit in its accustomed position under my desk, leading me to wonder whether I need a new one of those, too. So beware: upgrading your PC can lead to changing a lot of other things, too!



1 The cooler was chosen to fit a different case, so isn't perfectly integrated into this one. Despite this, it does a good job, with the CPU cores rarely topping 65 C.

2 The LED-topped RAM is now fully exposed, and can be made to ripple like the starship Enterprise's warp core.

3 A PCIe card adds four more USB 3 ports to the back of the machine, to make up for the Icy Box not fitting on the front.

4 One of the three M.2 slots remains empty and easily accessible, ready for the inevitable upgrades in the future.

Mistakes were made...

It's probably fair to say this upgrade didn't go 100 percent according to plan, and in fact, may be a cautionary tale about what not to do. PC components have changed a great deal in six years, even if clock speeds have only inched up. The 2950X's base clock of 3.5GHz is the same as that of the Core i7 it replaces. Elsewhere, though, the increases in memory bandwidth and storage speed, not to mention the processing horsepower of all those cores running at 4.1GHz, thanks to Precision Boost Overdrive, mean it's a much quicker system for some tasks. It's also the first system I've built that

has the same amount of RAM as the one it replaces, albeit running at twice the frequency.

This isn't a system built by an expert to show off or demonstrate a point; it's a real-world PC designed to accelerate the gaming and media tasks it's expected to handle, built with an eye on online bargains, and with the desire to recycle components. This last one didn't work so well – only the HDD, graphics card, and a USB 3 card remain from the original – but if this increases the rig's reliability, I'll be happy, as I use it all day, every day. The power supply,

in particular, could have blown, thanks to the extra draw.

The main lesson I'm drawing from this is that it pays to plan your build precisely and in detail. The clash between the RAM and cooler probably couldn't have been predicted – who checks the height of their sticks? – and if I'd stuck with the LPX RAM, a lot of trouble could have been avoided. I should have sucked up the price increase, perhaps returning the cheaper LED RAM in favor of something shorter, but I never could resist a bargain. There is such a thing as false economy, though; because of the RAM, I ended up with a new case, and maybe a new desk, and because I failed to discern the difference between SATA and NVMe, I've got two M.2 drives where one would have done.

As the build process neared its end, but before the problems with the case and cooler appeared, I reflected that it was one of the easiest I'd ever attempted. M.2 storage is a vast improvement over sliding drives into cages, mounting them with four screws, and running power and data connections. I'm endlessly thankful for the way RAM sticks can only be put in their slots one way, too, but there needs to be a better way to connect the front panel connections on a case to the motherboard – a bundle of unlabeled, thin wires with plastic blocks on the end isn't ideal, especially when you're dealing with them in the confines of a case. ■

BENCHMARK RESULTS

	APC LABS TEST PC	THIS SYSTEM
CINEBENCH R15 MULTI (INDEX)	2,178	3,116 (43%)
CRYSTALDISK QD32 SEQUENTIAL READ (MB/S)	3,136	3,512 (12%)
CRYSTALDISK QD32 SEQUENTIAL WRITE (MB/S)	2,126	2,304 (8%)
RISE OF THE TOMB RAIDER (FPS)	68	37 (-46%)
TOTAL WAR: WARHAMMER II (FPS)	42	27 (-36%)
TOM CLANCY'S GHOST RECON WILDLANDS (AVG FPS)	38	25 (-34%)
3DMARK: FIRE STRIKE EXTREME (INDEX)	6,988	4,551 (-35%)

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Our zero-point consists of an Intel Core i9-7900X, 32GB of G.Skill RipJaws V series DDR4 @ 3,000, an MSI GeForce GTX 1080 Ti Gaming X, and a 512GB Samsung 960 Pro PCIe SSD. All tests performed at 4K at the highest graphical profile.

howto

» QUICK TIPS

Experts solve your computing problems

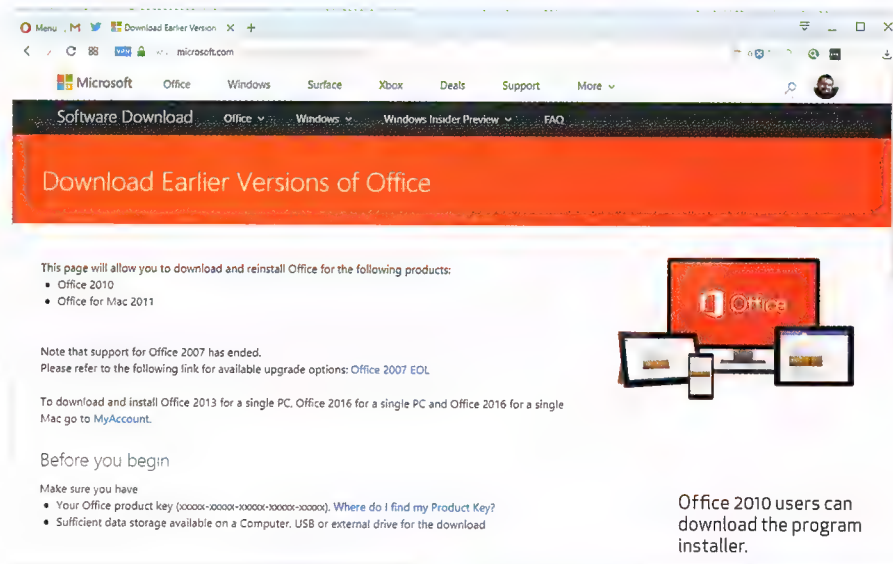
APC and its readers can be one giant helpdesk. If you have a technical problem, chances are one of us can solve it.

STORAGE

MOVE OFFICE TO A NEW HARD DRIVE

My Samsung R850 hard drive appears to have crashed, Windows 10 going into automatic recover mode and telling me to replace the drive whenever I try to boot from it. This means a new hard drive and new Windows 10 OS as my install discs are in another country for the next four months. Can I move Office 2010 from my Samsung N150 to the new drive? It's too slow for anything but photos.
Bob McKnight

First things first, there should be no need to buy a new copy of Windows 10, Bob. So long as it's a straight hard drive swap, then your Windows 10 license should be tied to your old PC – all you need to do is use the Media Creation Tool (www.microsoft.com/en-au/software-download/windows10) to create new media – see this month's lead feature for details. Skip the request for a product key and it should automatically activate after signing into your Microsoft account after installation. You will, however, need to reinstall Office 2010 from scratch – moving apps from one PC to another is never recommended – but the good news is you won't need to purchase a fresh



copy. You'll need your Office 2010 product key (if it's the same one as on your N150, use a tool like Licensecrawler (www.klinzmann.name/licensecrawler.htm) to obtain it. Then head over to www.microsoft.com/en-au/software-download/office, where entering the key will allow you to download the correct Office 2010 installer.

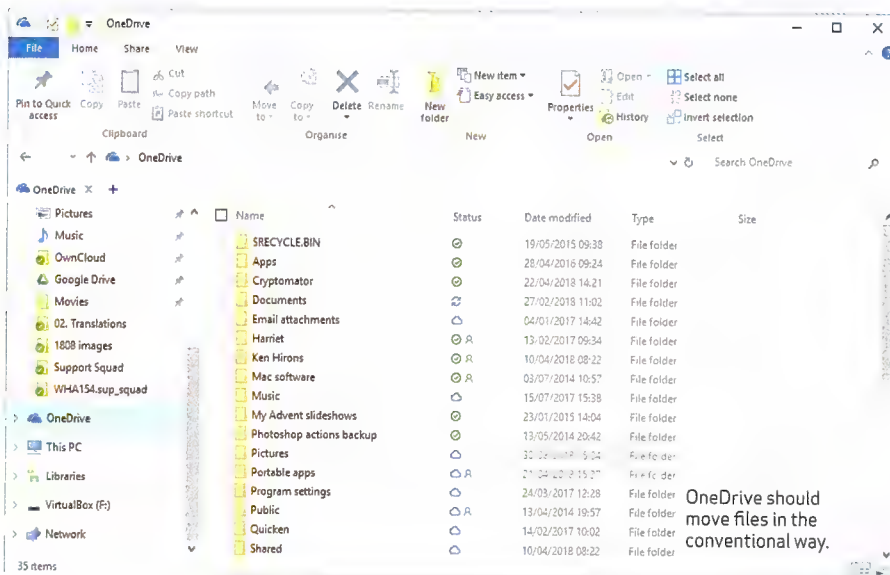
Nick Peers

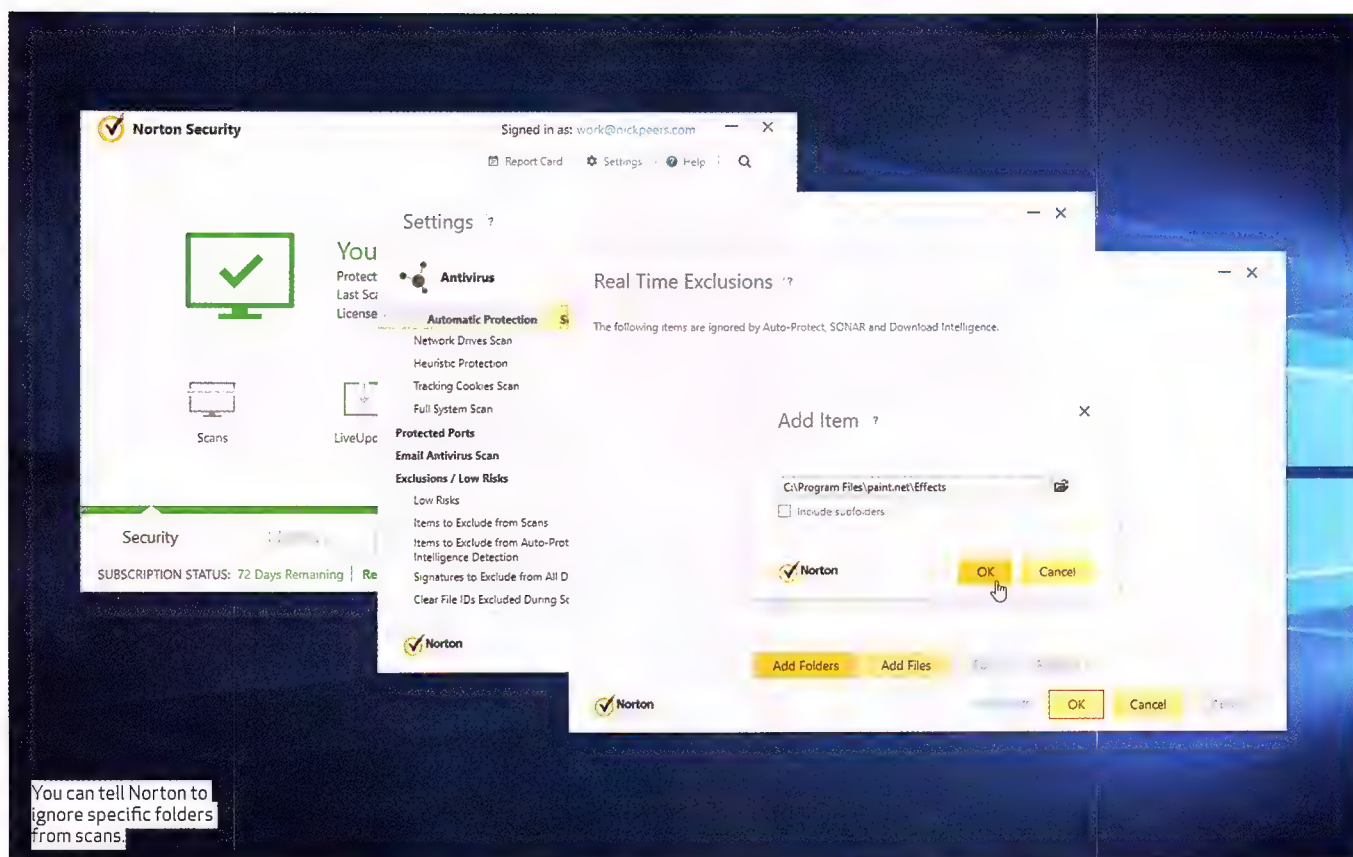
STORAGE

ONEDRIVE FILE DELETION CONFUSION

I organise my photos in OneDrive in subfolders in the main Pictures folder. I recently came across a Camera Roll folder with subfolders named in the same way. I decided to move these into the main Pictures folder, and then received an email from Microsoft saying I'd deleted files and that I had 30 days to restore them. I checked the Recycle bin and they're the same photos that appear to be in the main Pictures folder. Should I be worried?
Dave Lee

Don't worry, Dave, your files are safe. We're not sure what's happened here – ordinarily OneDrive moves files in the conventional way, which means they simply go to the new folder. The messages you're receiving suggest that the files were copied and then the originals were deleted – perhaps there were duplicated photos in the Camera Roll folder, and when you moved them, OneDrive may have asked if you wished to overwrite or replace duplicates. The process of doing so may have triggered the email alert. The key thing is that you're smart enough to verify that all the files are where they should be, allowing you to empty the Recycle





Bin – or let the 30-day deadline run down – at your leisure.
Rob Mead-Green

EMAIL TRANSFER THUNDERBIRD MESSAGES TO NEW PC

I'm in the process of transferring all the data from my old computer to a new one. I wish to set up Thunderbird so the app is on drive C, but its data files are stored on drive D. I have five email accounts, some of which I plan to switch to IMAP. Can you advise me how to set up Thunderbird so that immediately after setup my data files are located on drive D, please?
Robert Nesbitt

Thunderbird profiles are – by default – stored in a hidden location (press Win+R, type %appdata%\Thunderbird\Profiles and press [Enter] to access them). It's a case of moving the profile folder from here to a suitable location on your data drive. Now launch Thunderbird Profile Manager by pressing Win+R again, but this time type the following before pressing [Enter]: thunderbird-profilemanager. Click 'Create Profile' and select Next. Choose a new profile name and click 'Choose Folder...' to select the folder you moved to your data drive. Click 'Finish' followed by Start Thunderbird and your existing profile should be present and correct. Open the menu and choose Options > Account Settings, then check Server Settings for each account (scroll down

"The key thing is that you're smart enough to verify that all the files are where they should be."

to the bottom) to verify your messages are being stored inside the new profile folder; if not, click Browse to point to the corresponding folder on your data drive.
Cat Ellis

SECURITY NORTON BLOCKS PAINT.NET PLUGINS

Norton appears to be determined to prevent me from using any Paint.NET plug-ins – after installing it and running a scan, half of my plug-ins have disappeared. Any idea where they have they gone?
George Devonshire

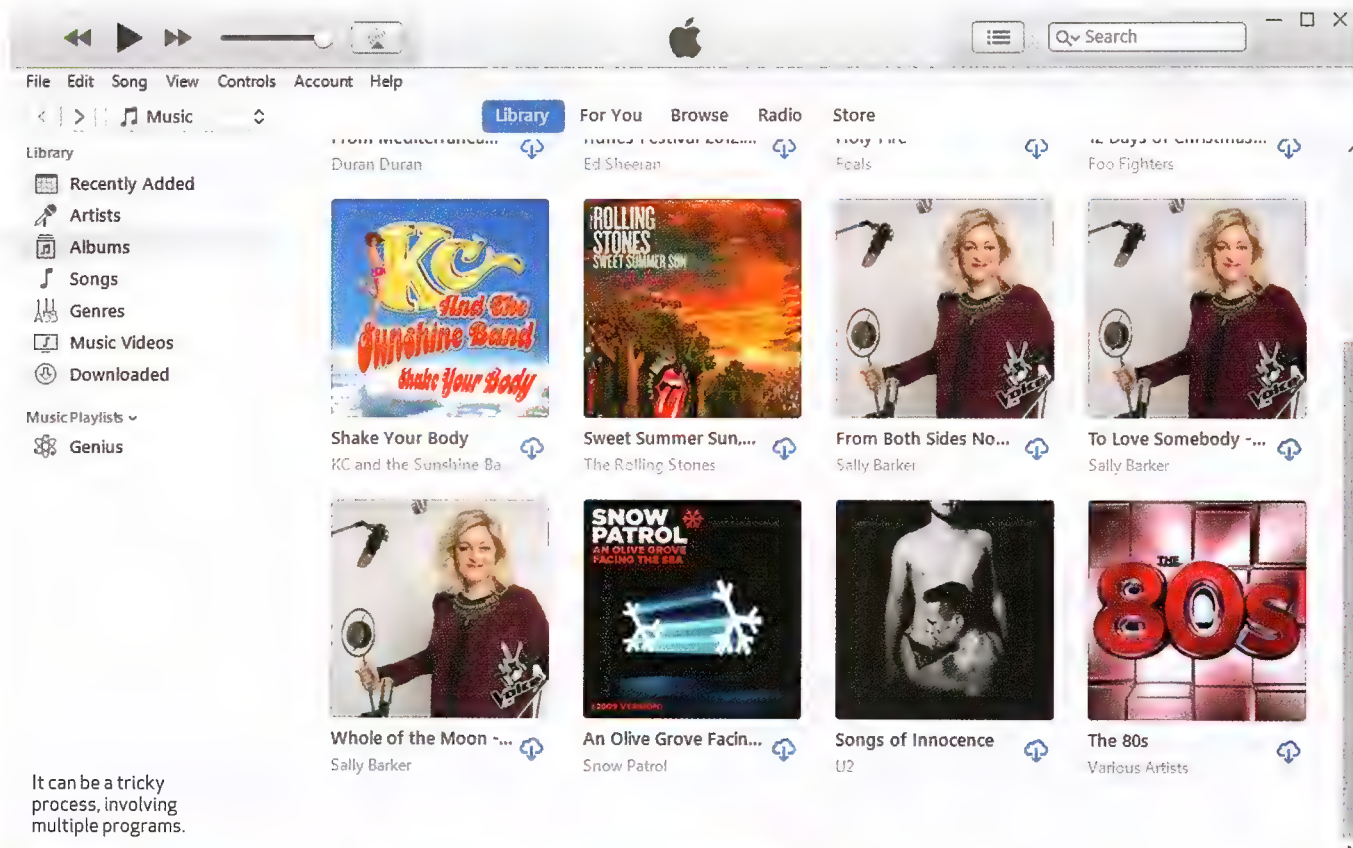
This kind of behaviour used to happen with older plug-ins – Norton appears to have cleaned up its act with newer ones. If you've recently switched anti-virus program to Norton, it might be worth checking to see if your plug-ins are up to date – if they're not, download the latest versions and see if Norton is happy to wave them through. If this fails, open Norton and click the Security icon. Select 'History' and choose Quarantine under the Show drop-down menu. You should find that

some or all of your plug-ins are located here – recover individual plug-ins by selecting one, clicking More Options and then choosing Restore. After a short pause it should be returned and the next time you launch Paint.NET it should be back.

If this becomes annoying, you can instruct Norton to ignore the plug-ins folder: open Norton again, but this time click Settings. Select 'Antivirus', switch to 'Scans and risks', then scroll down and click Configure next to 'Item to Exclude from Auto-Protect, SONAR and Download Intelligence Detection'. Click 'Add' > Folders and browse to C:\Program Files\paint.net\Effects. Select this folder and click OK twice – Norton will now ignore this folder going forward, and all your plug-ins should function normally.
Mayank Sharma

WINDOWS OLD OS DRIVE ON NEW PC

My question is this: having invested in a new SSD a year or two ago, can I simply transfer this – with Windows 10 – to a new self-build PC?
Eric Howman



"Anthony eventually used the problem as an excuse to perform a full reinstall of his PC."

Sadly not, Eric. Each Windows 10 install is tightly bound to the computer it's been installed on, configured to work with that specific hardware setup. You could, however, wipe the drive clean and transfer the SSD (solid-state drive) to your new PC to serve as your boot drive going forward.

Eric wanted to know if he could

transfer the Windows 10 license itself, too – it was the free update based on a retail version of Windows 7. Unfortunately, this can't be done either, because the license is also tied to Eric's old machine. Therefore, he will need to factor in the cost of a new copy of Windows 10 for his build, but at least he'll be able to save some

money by reusing his SSD as well as some of the other components from his old machine.

Rob Mead-Green

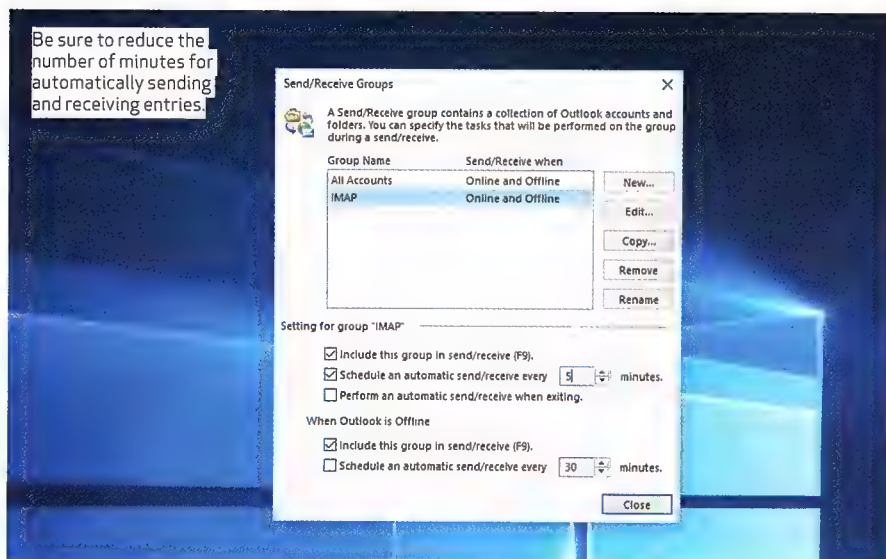
SOFTWARE CAN'T REMOVE APPLE SOFTWARE

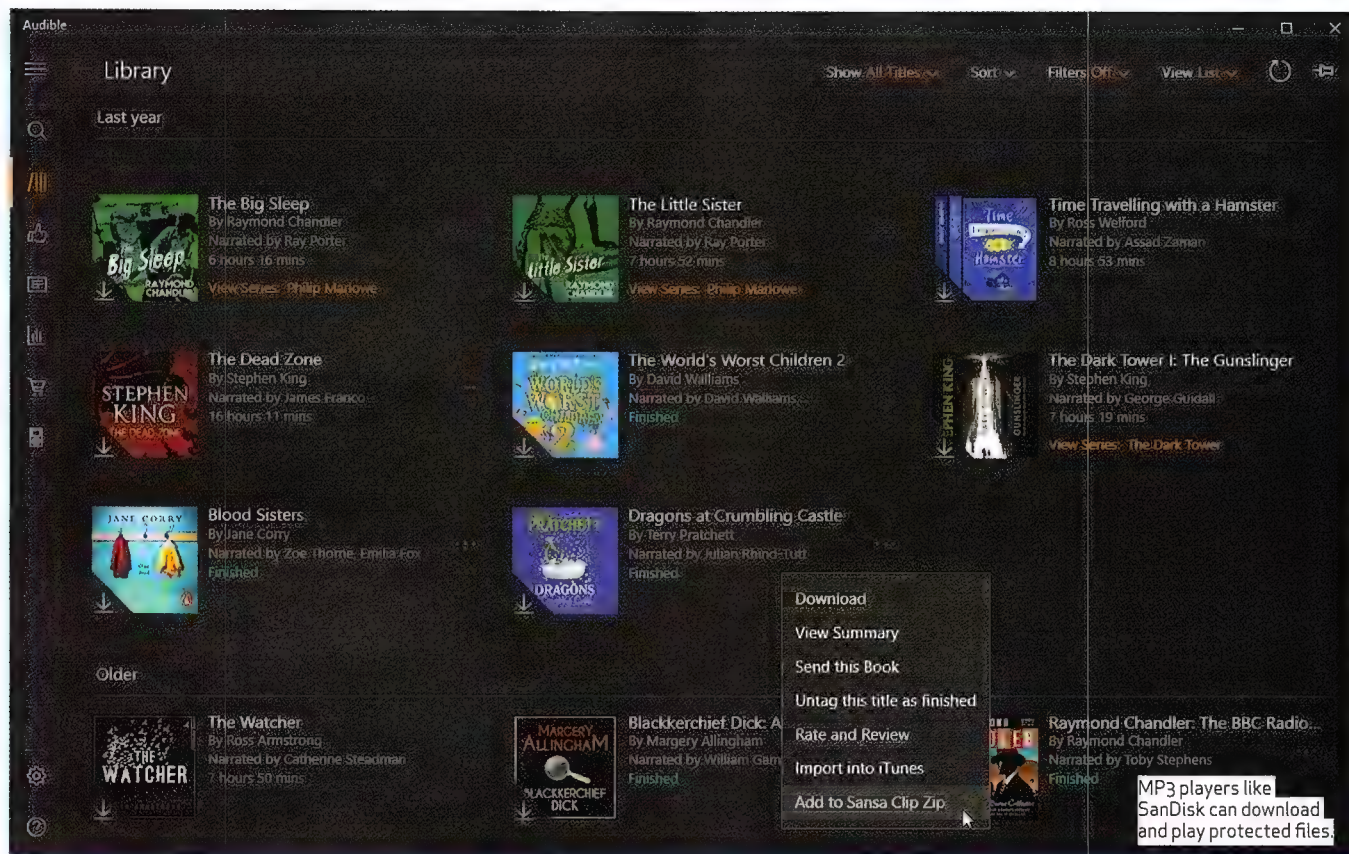
I'm trying to remove Bonjour and three other Apple software programs, but keep getting errors 2502 and 2503 respectively. I've tried a few things, but can't get rid. Please help!

Anthony Carter-Smith

Anthony eventually used the problem as an excuse to perform a full reinstall of his PC – the first time in 18-24 months. However, before going down this route it's worth examining the alternatives. These programs Anthony mentions are usually installed alongside iTunes or iCloud, and removing them requires you do so in a specific order as outlined at <https://support.apple.com/en-gb/HT204275>. In Anthony's case, this ship had sailed. Nor could he attempt to reinstall iTunes over the top of itself to start again from scratch. For those willing to pursue the troubleshooting approach, a comprehensive list of things to try can be found at <https://discussions.apple.com/docs/DOC-6562> – this should hopefully help steer you towards a solution.

Nick Peers





WINDOWS REMOVING A WINDOWS.OLD FOLDER

I have a laptop, which I reinstall Windows on every now and again, but I've ended up with a Windows.old folder taking up 38GB on my SSD. How can I uninstall or remove this folder?

Thomas Sudek

The existence of the Windows.old folder suggests that your Windows reinstalls have either been upgrade or repair installs, with the key files from the previous install left behind. Windows should automatically remove these after a set period, but for whatever reason they've built up to quite a size. Luckily, getting rid of them is easy. Start with the Disk Cleanup tool: Open File Explorer, right-click drive C and choose Properties, then click 'Disk Clean-up'. Once the initial scan completes, click 'Clean up system files' and wait. Once that's done, scroll down and see if there's an entry relating to previous Windows versions (hopefully indicating 59GB of space is available for cleaning). Tick this box before clicking OK along with any other boxes and you should be able to reclaim the space. If any files remain, try running Disk Cleanup again to see if it finds the leftover residue; if not, try holding Shift as you right-click the Windows.old folder in File Explorer and choose Delete. If you get a permissions pop-up, follow the

instructions and hopefully it'll be able to clear the remaining files once and for all.

Nick Peers

EMAIL OUTLOOK 2016 WON'T SEND OR RECEIVE EMAIL AUTOMATICALLY

When I open Outlook and go to my inbox, new email isn't automatically downloaded. I have to press [Shift] + [F9] to get it. Help!

Allan Bolton

Allan's problem with receiving email stemmed from the fact he was connecting to his mail using IMAP, which works in a slightly different way to traditional send/receive. The following steps should help resolve the problem.

Switch to the Ribbon's Send/Receive tab and choose Send/Receive Groups > Define Send/Receive Groups. Click 'New', then give the group a suitably descriptive name, such as 'IMAP'. Click 'OK', then select your account on the left.

Tick 'Include the selected account in this group' and verify that both the Send and Receive options are ticked under Account Options. Now right-click your account name and select 'Check all subfolders' to ensure that everything is ticked.

Click 'OK'. Make sure that IMAP is selected and verify both 'Include this group in send/receive (F9)' settings are ticked. Also make sure that

'Schedule an automatic send/receive every... minutes' is ticked – reduce the figure from 30 minutes to 5.

Now select 'All Accounts' and click Edit. Select your IMAP account from pane on the left, but this time untick the 'Include the selected account in this group' option. Click 'OK' followed by Close, then close and reopen Outlook to test. Everything should now work.

Rob Mead-Green

MEDIA AUDIBLE TO MP3 PLAYER

How do I transfer content from my Audible account to my SanDisk MP3 player?

Scott Poliss

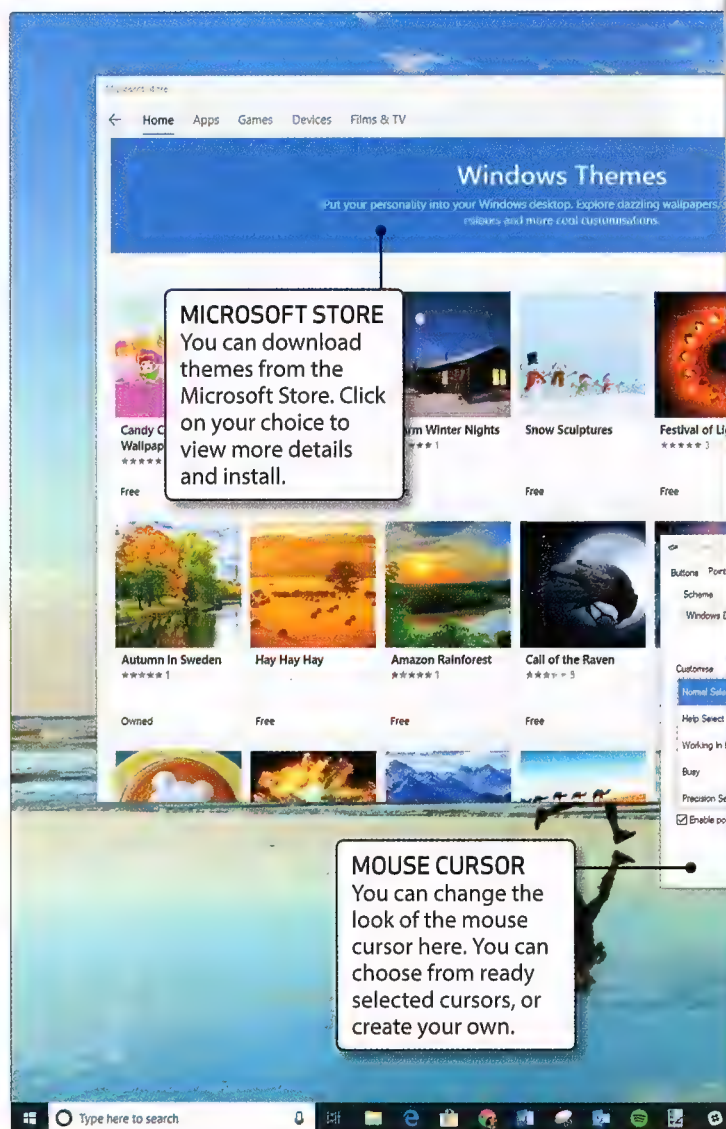
You'll need an Audible-ready device – most SanDisk players are – as well as the Audible app from the Microsoft Store (if you use Windows 7 or 8.1 then download Audible Manager from https://audible.custhelp.com/app/answers/detail/a_id/4723). Open the app on your PC and connect your SanDisk via USB. Activate when prompted, then adding titles is as simple as clicking the ellipsis (...) next to a title and choosing 'Add to Sansa...' You can also download content to either its internal memory or to an external microSD card.

Cat Ellis ■

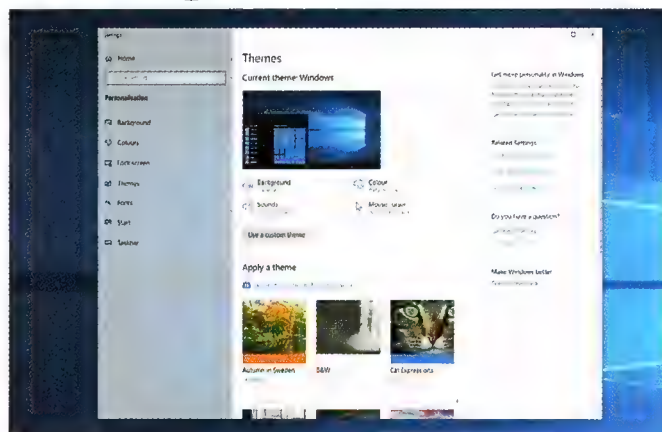
Personalise Windows 10

Matt Hanson Give Windows 10 a whole new look with the huge range of official Windows 10 themes.

Just as with previous versions of Windows, the look of Windows 10 can be customised using themes. These are collections of desktop wallpapers, menu colours and sounds that overhaul the look and feel of Windows. While Windows 10 comes with a few themes pre-installed, you can also browse and download from a huge variety of ready-made themes that have been picked by Microsoft. These are easy to download and apply to Windows 10, enabling you to give your PC that personal touch. Best of all, you can tweak these themes to better suit your tastes, or create your own themes and save them so that they can be easily applied in the future. Windows 10 themes can also be removed or swapped if you want to change the look in future. Here, we'll show you how to browse and install new themes, and how to create your own.

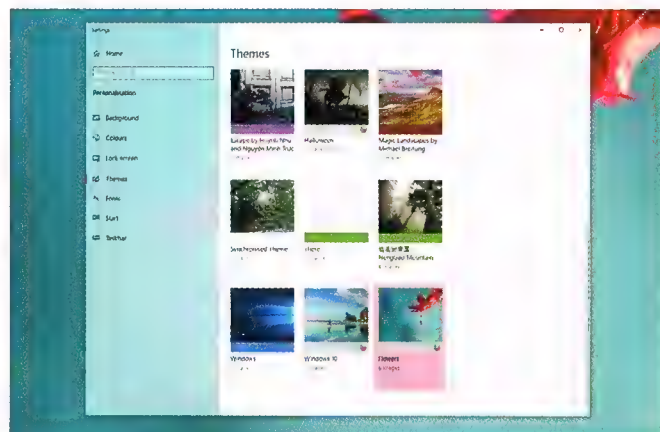


Change the look of Windows 10 with themes



1 VIEW CURRENT THEME

Right-click any free space on the Windows 10 desktop and select Personalise. In the window that opens, select Themes from the left-hand pane. You'll see the current theme that Windows 10 is using. A picture at the top shows you the background image and what the Start menu looks like. You'll also see the name of the image, the colours, mouse cursor and system sounds.



2 BROWSE AND APPLY INSTALLED THEMES

You'll also see pre-installed themes that come with Windows 10 (or ones that your PC manufacturer has created). These are listed under the 'Apply a theme' section. Each theme has a name, and will show one of the theme's desktop wallpapers and beneath the image will be a colour, which is the colour certain elements of Windows will change to. Click a theme to apply it.

THEMES
This is the main window where you can select the themes that you want to use in Windows 10.

THEME PREVIEW
This is a preview of the theme, giving you a quick guide to how Windows 10 will look with the theme applied.

INSTALLED THEMES
This is where the themes you have installed appear. Click on one to apply it.

SOUNDS
You can change the system sounds that Windows plays here. You can select from ready-made sounds or choose your own.

Jargon buster!

DESKTOP WALLPAPER

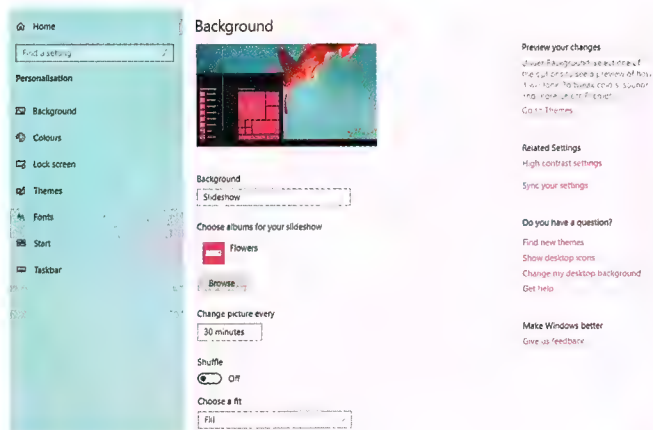
This is the background image that covers most of your screen when using Windows 10. Because of this, you'll want to pick a high quality image (or series of images) that don't make icons difficult to find.

SYSTEM SOUNDS

System sounds are the noises and tones that Windows 10 makes during certain tasks, such as when Windows 10 starts, or when you receive a notification. Many themes come with their own set of system sounds.

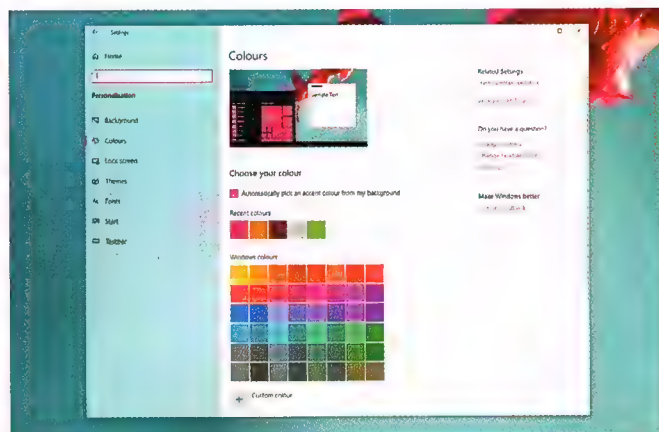
DESKTOP

The desktop is the main area of Windows 10 where windows appear, as well as icons for tools and apps.



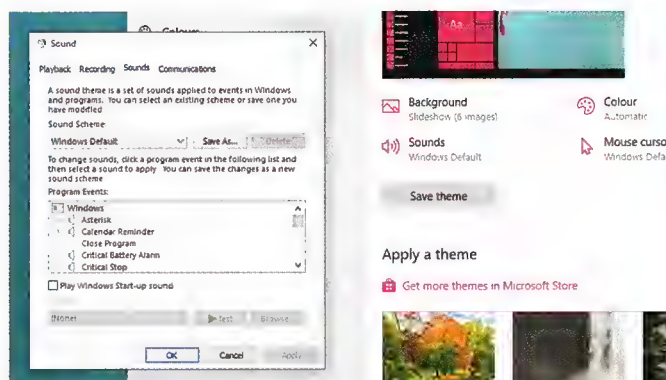
3 CUSTOMISE THE THEME: BACKGROUND

At the top of the Themes window, click Background. This takes you to a menu where you can change which images are shown on the desktop. Under 'Background' you can choose from Picture, 'Solid colour' or Slideshow. Picture shows a single image; Browse enables you pick an image on your PC; Slideshow enables you pick a number of images, and choose how often they change.



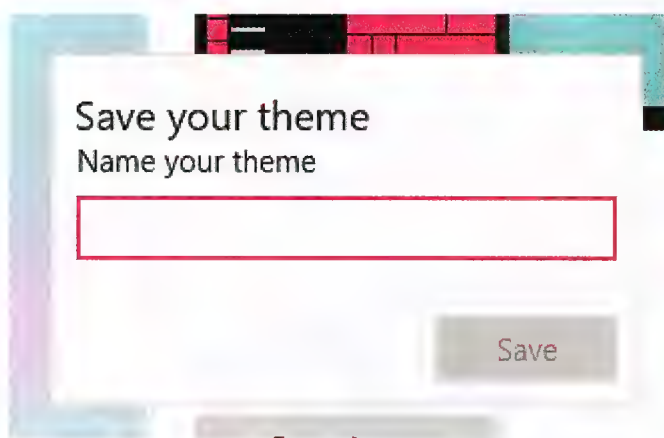
4 CUSTOMISE THE THEME: COLOUR

Changing system colours is another way to alter the look of Windows. From the main Theme menu, click Colours. At the top of the window you'll see an example of how any colour change you apply will look. Under 'Choose your colour' you can get Windows to automatically pick a colour based on your desktop background. You can also pick your own colour, if you wish.



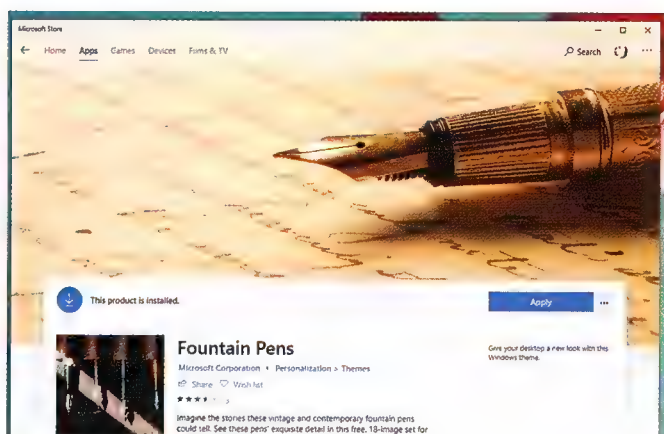
5 CUSTOMISE THE THEME: SOUNDS

You can also customise the sounds Windows plays. Click 'Sounds' to open a new window. You can choose from a pre-installed selection of sounds, known as a Sound Scheme. If you don't want any sounds to play, choose No Sounds from the Sound Scheme drop-down menu. You can also tweak a Sound Scheme. Click an Event, then choose a sound to accompany it.



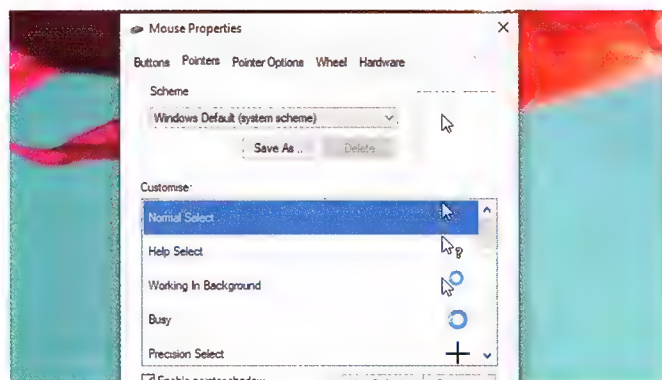
7 SAVE YOUR THEME

Once you've created a theme, click 'Save theme'. A pop-up window will appear where you can enter a name for it. Choose one, then click Save. Your theme will now appear in the 'Apply a theme' section. If you want to apply that theme in future, all you need to do is click the theme you've created. To delete a theme, right-click its preview and then select Delete.



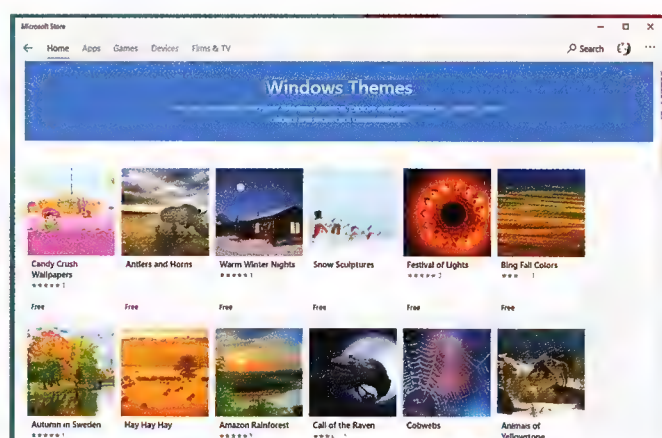
9 INSTALL A THEME

If you want to download and install a theme, click Get. If the theme is free, a new page in the Microsoft Store will open, so click Install. Otherwise you need to pay for the theme using a payment method set up with your Microsoft account. After the download and installation process is complete, you'll be told that the 'product is installed'. Click 'Apply' to start using the theme.



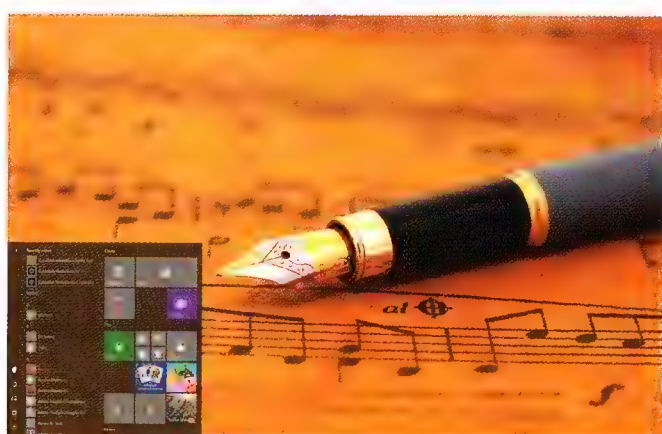
6 CUSTOMISE THE THEME: MOUSE CURSOR

You can also change the mouse cursor. This is the pointer that moves when you move your mouse, and from the window that opens, you can select the look of the mouse using a Scheme. Some enlarge the cursor or use inverted colours to make it easier to find. You can also make your own – click Browse and choose an image to use. Click 'Save as' to create your own Scheme.



8 BROWSE MORE THEMES

The Microsoft Store is also home to a growing number of excellent Windows 10 themes, most of which are free. To browse them, click the 'Get more themes in Microsoft Store' link in the main Themes window. This will open the relevant page on the Microsoft Store app. If you see one you like the look of, click it to see more details, including which wallpapers come with it.



10 ENJOY YOUR THEME

You now have a new (or several new) themes for Windows 10 that makes your PC feel more 'you'. There are a huge range of official themes to choose from, but for an extra personal touch, why not make your own theme using photos you've taken, perhaps of your family or a recent holiday? Make sure you save your theme as well, so you can apply it now or in the future.

HOW TO:
PLAY GAMES ON LINUX

RETRO GUIDE:
DOSBOX EXPLAINED

DISCOVER THE BEST FREE
SOFTWARE FOR YOUR PC

AUSTRALIA'S #1 PC GAMING MAG

PC PowerPlay

**BUILD A
BUDGET
GAMING PC**
AND SPEND LESS
THAN \$1000!

**THE YEAR IN
HARDWARE**
WE LOOK AT WHAT
THE NEXT 12 MONTHS
WILL BRING

THE
GAMES
OF 2019!
WHAT YOU'LL
BE PLAYING
THIS YEAR

2019 Technical Handbook special



HARDWARE AND TECH SPECIAL 2019 • \$13.99 • 112 \$15.99
PRINT POST APPROVED: 100003375 • ISSN: 1326-5644

EVERYTHING YOU NEED TO KNOW ABOUT
GETTING THE MOST FROM YOUR PC

SPEED UP AND TWEAK WINDOWS
PC BUILDING BIBLE • BETTER BENCHMARKING

THE VERY LATEST GAMES, THE MOST CUTTING-EDGE
PC HARDWARE, AND EVERYTHING IN BETWEEN,
ALL IN AUSTRALIA'S OLDEST PC GAMING MAGAZINE!

ON SALE NOW



Manage your smart home

Alex Cox replaces Apple's Home app with an arguably better HomeKit manager.

When you're managing your HomeKit accessories, it's natural to head for Apple's own Home app. That's logical, and it'll get the job done, but it's not necessarily the best choice. Home's design pushes certain aspects of accessory control into the background – try tweaking the colour of your lights, for instance, and you'll need to navigate through at least two screens before you're given the option.

Even if you don't own a single Eve accessory, the Eve for HomeKit app is one you owe it to yourself to try. It's compatible with everything HomeKit, and in many cases it makes it much quicker and easier to get things done. You can see the exact status of all your accessories

and access their basic controls from a single page; bring up the controls for your living room, for example, and you could alter your lights, your thermostat and more, with all the necessary controls shown in that one place.

KEEPING TRACK

The Eve app is also virtually unparalleled in terms of tracking. If you're using HomeKit-compatible sensors, like smart plugs, air-quality monitors or even motion sensors, you'll be able to track their activity and even view long-term analytics of their readings.

You don't even have to leave the app to add new accessories to your HomeKit setup – you may never use Apple's Home app again.

"You can see the exact status of all your accessories and access their basic controls from a single page."

DEFAULT ROOM

-  **Philips hue - 7FA212**
PHILIPS HUE - 7FA212 
-  **Hue color lamp**
HUE COLOR LAMP 
-  **Hue color lamp**
HUE COLOR LAMP 
-  **Hue dimmer switch button 1,...**
HUE DIMMER SWITCH 

KITCHEN

-  **Strip Lights**
BEAM
-  **Eve Energy**
EVE ENERGY A230 

LIVING ROOM

-  **front**
LIFX 277997
-  **rear**
LIFX MINI 3257B2
-  **Eve Door**
EVE DOOR F134 

Want to monitor your energy usage? The Eve Energy plug is one of the few smart plugs that log electricity usage.

How to

Take better control of your home with Eve.

< Search

eve.

Eve for HomeKit

Eve Systems GmbH

4.0

★★★★☆

120 Ratings

4+

120 Ratings

What's New

Version History

1 GRAB THE APP
Once you've downloaded the Eve for HomeKit app, run through its initial setup steps. If you've used Apple's Home app before, or set up any HomeKit hardware, you'll see those accessories featured in the Eve app already.

Include in At A Glance

Done

Hue color lamp

DEFAULT ROOM

☆

Hue color lamp

DEFAULT ROOM

☆

Hue dimmer switch

DEFAULT ROOM

☆

Strip Lights

KITCHEN

★

Eve Energy

▲

4 ORGANISE IT
Tap 'At a Glance' and you'll see the new accessory, but you might not see all others yet. Tap Edit and mark accessories you want to see in this page with a filled-in star. Drag on the handles to the right of each row to reorder the accessories.

Projected Cost

0 £/yr ▶

Total Consumption

1.60 kWh ▼

77 Wh

256 Wh

11 00

12 00

No previous data

18 NOW

7 MONITOR IT
Some smart plugs, like the Eve Energy, will keep tabs on your power usage. Take a peek at it on the 'At a Glance' page to see power consumption and costs for the day; tap the blue icon with an ellipsis in it to look back further.

Cancel

eve

Finding accessories...

Make sure your HomeKit accessories are close to this iPhone.

Strip

ID

2 ADD SOMETHING NEW
Tap Settings (bottom bar), then tap + at the top right. The app will find new HomeKit accessories within Bluetooth range, and any HomeKit devices that support proximity-based setup but have not yet been added in Apple's Home app.

At a Glance

Edit

On Strip Lights

KITCHEN

On Eve Energy

KITCHEN

On front

LIVING ROOM

On rear

LIVING ROOM

23.1°C / 49%

Eve Room

LIVING ROOM

Open

Eve Door

LIVING ROOM

5 CONTROL IT
You should now see your favoured smart gadgets in the 'At a Glance' page. This gives you immediate readings of sensors, and you can tap accessories, such as lights and smart switches, to toggle them on or off.

Types

Edit

Air Quality

LIVING ROOM

Temperature

LIVING ROOM

Humidity

LIVING ROOM

Power

DEFAULT ROOM, KITCHEN, LIVING ROOM

Consumption

KITCHEN

8 ALL TOGETHER
If you're running multiple smart plugs, tap Types, then Total Cost to check overall power draw. This tab also consolidates other info – for lights and door sensors, say, so you can check (and tweak) aspects of your home here.



3 SCAN THE CODE
Find the HomeKit code included with your accessory (on its documentation, on the accessory itself, or both), then name it and set the room it's in. It will then appear in both the Eve for HomeKit and Apple Home apps.

Power

OFF ON

Color

Brightness

100%

6 INVESTIGATE IT
Hold a finger on an accessory (or apply light pressure if your device has 3D Touch) to take a peek at more status info. Slide your finger (or apply extra pressure) to pop open a panel where you can alter more intricate settings.

Cancel

Add Rule

Next

A rule needs at least one trigger. It can have conditions that must all be met. As a result it sets one or more scenes.

Triggers

Conditions

Scenes

→

→

9 AUTOMATE IT
Scenes, timers and rules can all be managed in the Scenes tab. You'll need a device acting as a home hub (bit.ly/mfhmhuhub) to perform all the actions, but Eve's interface makes building routines a little easier than in the Home app.



Hidden powers of the Alt key

Unlock special shortcuts that speed up common actions.

Alan Stonebridge shows you how.

The Alt key – or, in proper Mac parlance, Option, though it isn't labelled as such on all Mac keyboards worldwide – is literally your key to a world of shortcuts and alternative behaviours. You might have a sense of this already from our Genius Tips troubleshooting advice; the first step in solving some software problems is to hold the key

to reveal a link to your user account's Library folder (where you can carry out certain maintenance tasks) in Finder's Go menu.

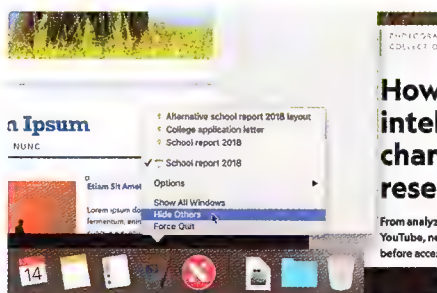
Similarly, you may have encountered the key's powers elsewhere, by accident, when idly tapping it and other modifier keys while you explore the contents of menus.

Here you'll discover some of the Alt

key's uses in macOS and a few of the apps that come with it. When you've finished reading these tips, it's worth opening other apps you use a lot and working your way through their menus, pressing and releasing the key to see what changes, if anything, and how it may make your Mac life easier.

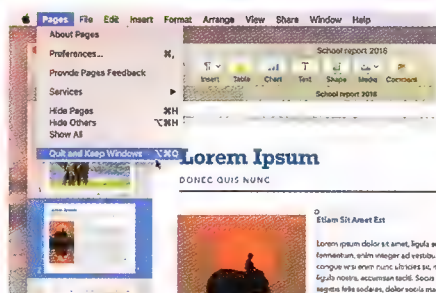
How to

Unlock hidden macOS behaviours



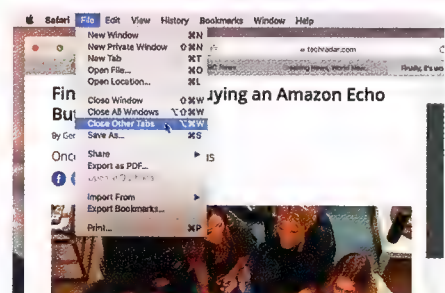
1 HIDE OTHER APPS

Want to focus on one app? Rather than move it to a new desktop in Mission Control, ⌘-click its Dock icon, hold Alt and choose Hide Others (or Alt-click its Dock icon). Other apps disappear; switch to one and its windows will reappear.



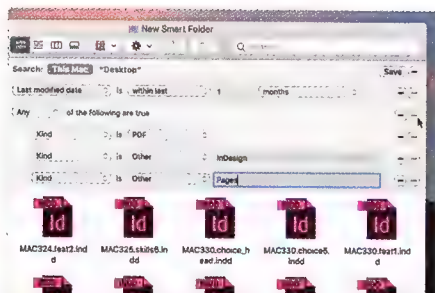
2 QUIT AND REMEMBER

Quitting an app usually causes it to forget its windows, unless you hold Alt and choose [app name] > Quit and Keep Windows. To make this the default (and use ⌘ to forget windows), turn off 'Close windows...' in System Prefs' General pane.

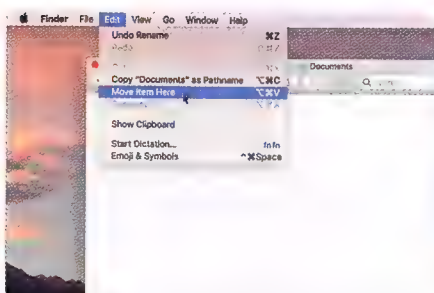


3 CLOSE OTHER TABS

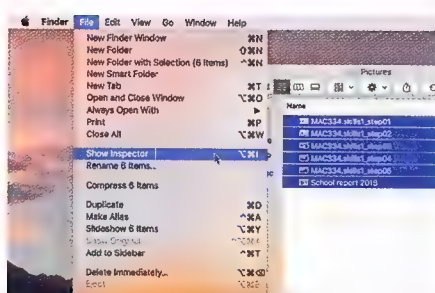
Ended up with a lot of Safari tabs open? You can close them one at a time by pressing Command+w, but press Alt+Command+w and all tabs but the current one will close. If the tabs are in multiple windows, use Window > Merge All Windows first.



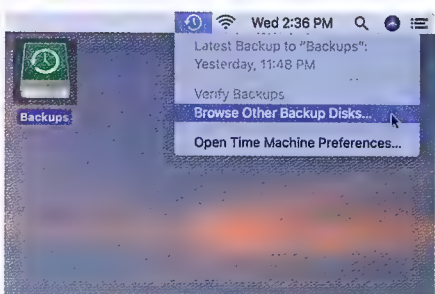
4 SMARTER FOLDERS
In Finder, choose File > New Smart Folder. Set a criterion, then hold Alt and the + button changes to an ellipsis ('...'); click it to add a group of criteria; the Smart Folder can be set to match against all, none or any of the rules in this group.



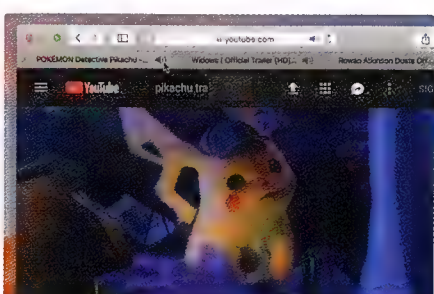
5 MOVE FILES IN ONE STEP
Dragging files to move them is, well, a drag – and on a trackpad, it's easy to let go too soon. Use Command+C to copy items to the Clipboard, go to the destination and use Alt+Command+v to move them and not have to delete the originals manually.



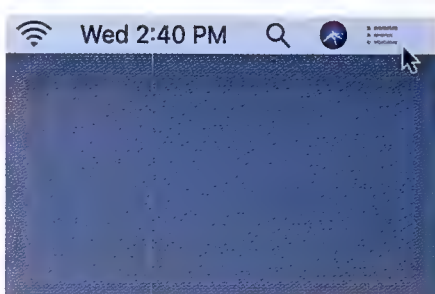
6 CUMULATIVE FILE SIZES
With multiple files selected, File > Get Info gives you one window for each item. Hold Alt and the command becomes Show Inspector, which opens one window that updates with your selection (hold Command while clicking to add/remove items).



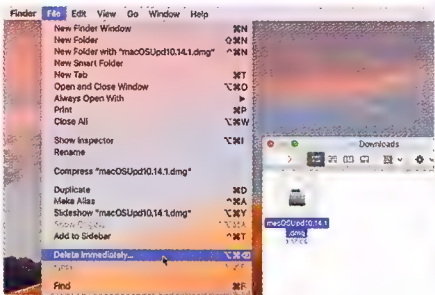
7 BROWSE OLD BACKUPS
Got an old Time Machine drive you need to browse? First, if Time Machine's menu bar icon isn't visible, turn it on in the feature's pane in System Prefs. Next, click that icon, hold Alt, choose Browse Other Backup Disks and pick one.



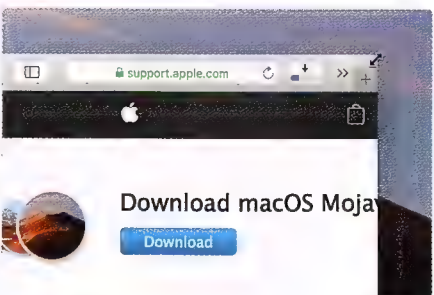
8 MUTE OTHER TABS
If you end up with multiple Safari tabs playing audio at the same time, hold Alt and click the speaker icon on the one you want to hear – probably the one you're looking at. There's also a command for this in the Window menu.eneral pane.



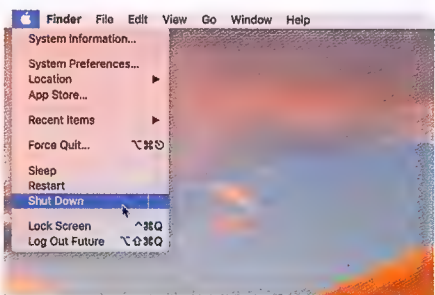
9 MUTE NOTIFICATIONS
Rather than taking two clicks to turn on Do Not Disturb (Notification Centre's icon, then a switch), when you want peace and quiet, simply hold Alt and click Notification Centre's menu bar icon; it's dimmer when notifications are muted.



10 DELETE FILES RIGHT AWAY
To remove a file immediately, without emptying everything else from the Trash – open Finder's File menu, hold Alt and 'Move to Trash' becomes Delete Immediately. Prefer keyboard shortcuts? Select the file and press Alt+Command+J.



11 RESIZE TO FILL DESKTOP
Rather than use a window's green button or drag its corners to make it bigger, hold Alt and double-click a corner to fill the desktop. Hold Alt when resizing a window to do so in two directions at once – to make it wider, say, in one action.



12 CBYPASS DIALOGS
The ellipsis ('...') after a menu item means it'll display a dialog. If the ellipsis disappears when you hold Alt, the dialog's defaults will be applied. In cases like the Log Out command, this triggers the default (highlighted) button's action.

Extending your editor to email and video

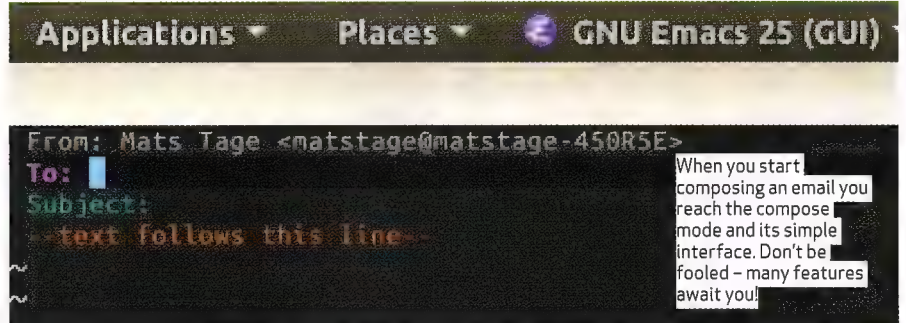
Carrying on from last month's Emacs instalment, Mats Tage Axelsson, turns his attention to how the editor handles email, video editing and more.

Once you get used to *Emacs*, you won't want to leave. Well, at least that's what uber-geeks think. The thought isn't totally nonsensical, though, because most people use a range of applications. Whatever you're writing, be it code or documents, *Emacs* can be used as a way to reduce distractions while you tackle the task at hand. From experience, if you start switching to work in other applications, your attention may start to wander.

Why not consider using *Emacs* for your email, at least when you're in the middle of something? Another advantage with this approach is that you can send what you're already writing directly from inside *Emacs*. Cut and paste will be less hassle. As you'll see, you're also able to format your emails.

There are a few more points to consider. One is whether to use *Emacs* for connecting to your mail server. When you're fetching emails, *Emacs* will stop working. For this reason, it's a good idea to employ external tools to receive any emails while you use *Emacs* to read and write. You can also use *Emacs* for video-editing, although whether it's a fast and efficient option is another matter altogether.

Rmail is the default email reader for *Emacs*. It supports POP3 and can handle newsgroups, too. As a matter of fact, *Rmail* has most of the features available like many other packages, but you'll



need to collect them yourself. The configuration is simple, and usually it just works. This is Richard Stallman's favourite, or at least he's stated that he'll consider it important even though he doesn't know how many users have it.

Gnus combines email and news reader functions. It was initially used as a newsreader, but the program has been developed to support RSS and email. With the correct settings, you can read, edit and send your emails from within *Emacs*. A word of warning: you must get used to thinking of your emails as news. This aspect will not change, so get used to it or use one of the other packages.

THE EMAIL ALTERNATIVES

There are several alternatives available for reading and sending emails in *Emacs*. Your choice will depend on your current system, your requirements and how important it is for you to have either speed or low storage space. Some

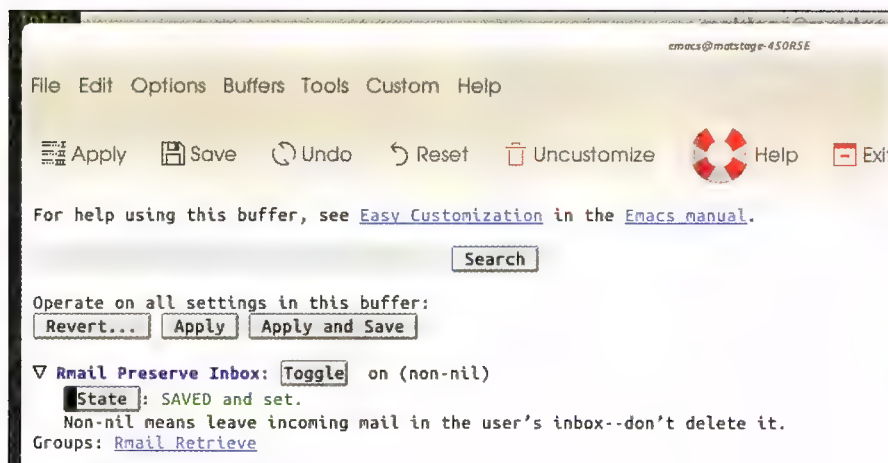
clients store more emails so they're likely to be faster, but this isn't always desirable. When reading emails in *Emacs*, you'll just want to stay with your editor without switching over to a separate email client, but there are other reasons to use email directly in *Emacs*. One is to be able to copy and paste, or even run scripts that create the email.

Before you start using email with *Emacs*, you need to decide how to fetch and send your emails. First, decide on the protocol: either POP3 or IMAP4. You must also make sure you know what the system does with your emails on the server.

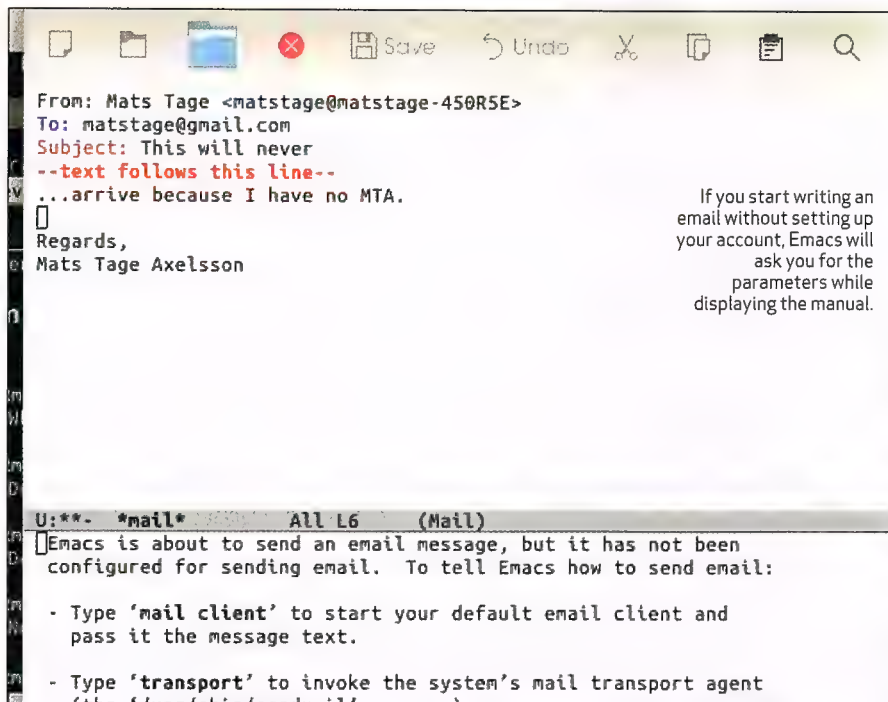
Before you do anything, set `rmail-preserve-inbox` to `t` or `vm-pop-expunge-after-retrieving` to `nil`. This is especially for using POP3. Oddly enough, the standard mode is to delete everything on your email server.

There are many options for fetching your emails. The easiest method is to use separate client software, most commonly either *offlineimap* or *mbsync*. For *Emacs*, the standard email reader is *rmail*. The most basic use of *rmail* is to read your mail spool directories. You can also instruct *rmail* to connect directly over the network, but this will usually result in *Emacs* being unavailable during the update procedure. This will impede your writing, assuming you only use *Emacs* for your work.

Many packages remove files from the server when they fetch them. Make sure you stop that from happening. Another great package that helps is the *offlineimap* package. You can use it to read your emails and store them locally, or sync to your local file system. You can set up *offlineimap* in the corresponding `.offlineimaprc` file, but that's a little cumbersome and error-prone. A better alternative is to use *mutt-wizard* to set your accounts up. Combining this with *mu4e* is also useful.



This is the most important parameter, set this value to non-nil to ensure you do not lose your emails.



If you start writing an email without setting up your account, Emacs will ask you for the parameters while displaying the manual.

To install *mu4e*, use *apt* as usual:

```
# sudo apt install mu4e
```

This is just the beginning. *Mu4e* is part of *mu*, but if you look through the packages in MELPA you won't find *mu* or *mu4e*. What you will find are extensions to the suite that meets special requirements, such as if you come from *vi* and use evil mode. Using any of these tools may also fail even after this point because the load file isn't available. Here's how to set the load-path, using one of your configuration files:

```
(add-to-list 'load-path "/usr/share/Emacs/site-lisp/mu4e/")
```

The path will usually be the same on all systems, but if you have a problem use the *find* command to figure out where it is. You should be able to read the mail directory that's specific for your system. The usual place is in your home directory as a hidden file:

`~/mail/` or `~/Mail/`. The location is configured by your mail fetching agent. Many users have reported that they find *offlineimap* to be slow, so they're using *mbsync* instead. This package is included in *isync* when you install it using your package manager.

You can also configure your system for several accounts. To do this you'll have to add some more code to your configuration. The first thing is a list of your accounts; the code below is an example of how to do it:

```
(defvar my-mu4e-account-alist
  '(("yahoo"
     (mu4e-sent-folder "/"
       yahoo/Sent")
     (mu4e-drafts-folder "/"
       yahoo/Drafts")
     (user-mail-address
       "matstage@yahoo.com")
     (smtpmail-default-smtp-
```

```
server "smtp.yahoo.com")
  (smtpmail-local-domain
    "mail.yahoo.com")
  (smtpmail-smtp-user
    "matstage")
  (smtpmail-smtp-server
    "smtp.yahoo.com")
  (smtpmail-stream-type
    starttls)
  (smtpmail-smtp-service
    25))
  ("abc"
   (mu4e-sent-folder "/abc/"
     Sent")
   (mu4e-drafts-folder "/"
     abc/Drafts")
   (user-mail-address
     "taggen@abc.se")
   (smtpmail-default-smtp-
     server "smtp.abc.se")
   (smtpmail-local-domain
```

```
"abc.se")
  (smtpmail-smtp-user
    "m9779")
  (smtpmail-smtp-server
    "smtp.abc.se")
  (smtpmail-stream-type
    starttls)
  (smtpmail-smtp-service
    587))))
```

Once you have those things set up, it needs to be called. In this case, we create a dialog that asks which account you want to send from:

```
(defun my-mu4e-set-account
  ())
  "Set the account for
  composing a message."
  (let* ((account
    (if mu4e-compose-
      parent-message
        (let ((maildir
          (mu4e-message-field mu4e-
            compose-parent-message
              :maildir)))
            (string-match
              "/\\/(.*?\\)/" maildir)
            (match-string 1
              maildir))
          (completing-read
            (format "Compose with account:
              (%s) "
                (mapconcat #'(lambda (var) (car
                  var))
                  my-mu4e-account-alist "/")))
            nil t nil nil (caar my-mu4e-
              account-alist))))
    (account-vars (cdr
      (assoc account my-mu4e-account-
        alist))))
    (if account-vars
      (mapc #'(lambda (var)
        (set (car
```

Primer: SpacEmacs layers

Because *Emacs* has so many options, enthusiasts have created so-called distributions that set everything up the way they like it. *SpacEmacs* is such a distribution but with added flexibility. One of the features of *SpacEmacs* is configuration layers. Each layer is used for a specific specialisation, usually a programming language. An example is HTML and JavaScript: they're the first entries in the default configuration file *.spacEmacs*, where the layers are defined. That definition is done in the variable *dotspacEmacs-configuration-layers*. If you want to tweak your setup, you have two options. One is to add variables in this file and the other is to create your own layer.

Experienced users of *Emacs* might wonder why *SpacEmacs* users don't install packages using MELPA? The reason is that *SpacEmacs* will consider your packages unnecessary at the next restart and remove them. Your own variables have their own space in the file *dotspacEmacs/user-config*. When you have many changes to make and also the packages you need, the better choice is to create a layer. Just add it to the *spacEmacs* config file and put your code in the private directory with the matching directory name.


```
var) (cadr var)))
      account-vars)
      (error "No email
account found"))))
```

For this code to run you add a hook for when you want to send an email. This results in *Emacs* asking you which account to use before you send:

```
(add-hook 'mu4e-compose-pre-hook
' my-mu4e-set-account)
```

When *mu4e* is set up, you start in the main mode and this is where you start your journey. The options are mostly different search options conveniently presented on this page. You choose the four main ones with the mnemonic [bu], where u means unread, [bt] means today's, [bw] means the week's and [bp] means pictures. You can also configure your own search. Apart from searching for specific files, it can also update your local mail. This is what you configured earlier when you picked either *offlineimap* or *mbsync*.

Once you've carried out a search, you end up in the headers view where all the matching emails show up. Here you can manage the email using d to mark for deletion and r to archive.

You can also view the mails by pressing Enter. The emails are rendered fairly well – while HTML support is there, you don't always get the correct view.

If it's important to see graphics, then you need to set your values for allowing inline images in your view:

```
;; enable inline images
(setq mu4e-view-show-images
t)
;; use imagemagick, if
available
(when (fboundp 'imagemagick-
register-types)
(imagemagick-register-
types))
```

You'll also want to set a large number of other parameters. For reading more advanced emails, you can obtain better results using *pandoc*. To define this you need the following code in your *init*. file:

```
(setq mu4e-html2text-command
"iconv -c -t utf-8 | pandoc -f
html -t plain")
With this in your settings, you
can now view HTML messages with
the pictures.
```

A powerful way to combine tools is to integrate your emails with *org-mode*. This can be useful in many ways, one is to be able to add tables in your emails. The other is to read an existing email and directly make it a *TODO* item in your main *TODO.org* file. To do this, set up the connections in your config:

```
(require 'org-mu4e)
(define-key mu4e-headers-
mode-map (kbd "C-c c") 'org-
mu4e-store-and-capture)
(define-key mu4e-view-mode-
map (kbd "C-c c") 'org-mu4e-
```

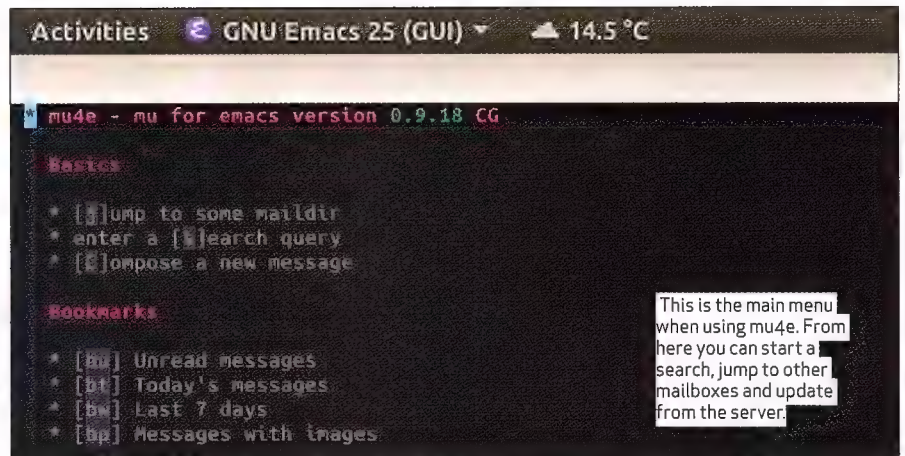
Keeping emacs simple

Emacs has so many settings and functions that it can get a little overwhelming. Sometimes all you want is a limited range of functions that are suitable for the task in hand. To work with an *Emacs* client that does very little, you need to launch it with only what you need. But then you have an *Emacs* session you'll need to start all over again.

A better solution is to have flexible setups and be able to quickly switch between them. *CHEmacs* is a script that you can download from GitHub and install in your home directory. It replaces your

.Emacs file and is run before you start *Emacs*. Because it's run before *Emacs* itself, you can't download it from MELPA or any other repository. The setup is fairly simple: after you've downloaded the repository, you need to create a file with the names and paths in *elisp* format. With this setup, you can also have different *Emacs* setups running in parallel.

The best use of this package is to try out other people's configurations and different distributions. *SpacEmacs* is a great example, because getting used to handling your own preferences takes some time to get used to. Another distribution you can use is *Doom-Emacs*, together with an evil plus *Emacs* version.



```
store-and-capture)
;;store org-mode links to
messages
;;store link to message if in
header view, not to header
query
(setq org-mu4e-link-query-in-
headers-mode nil)
```

With this in your settings, the keys are available in *headers-mode* and *view-mode* so you can plan immediately. Of course, email isn't your to-do list, and you can only do five things to an email: delete, read and delete, read and archive, reply and archive and finally add to the to-do list and archive. With this system in your mind and a great search function, you can also skip all file folders and learn how to use *Mu4e*'s search functions more effectively.

To make the to-do list a real agenda, you'll need to set a date and time, including a priority for the entry. The best way to do this is to create a template for the item. Here's an example of how to do that:

```
(setq org-capture-templates
'(("t" "todo" entry
(file+headline "~/todo.org"
```

"Tasks")

```
"* TODO [#A] %?\\
nSCHEDULED: %(org-insert-time-
stamp (org-read-date nil t
\\'+0d\\'))\\n%a\\n")))
```

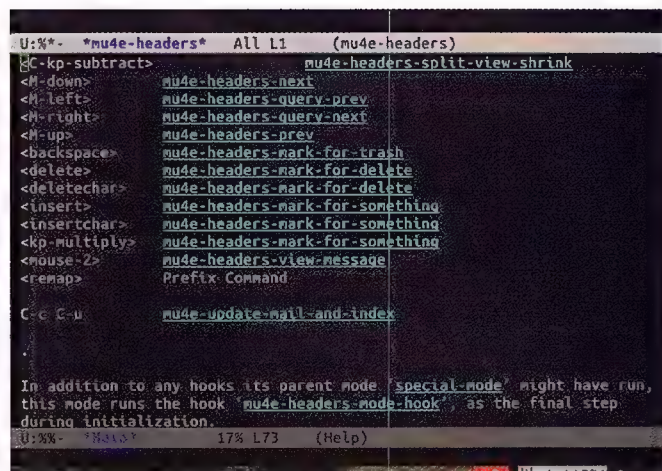
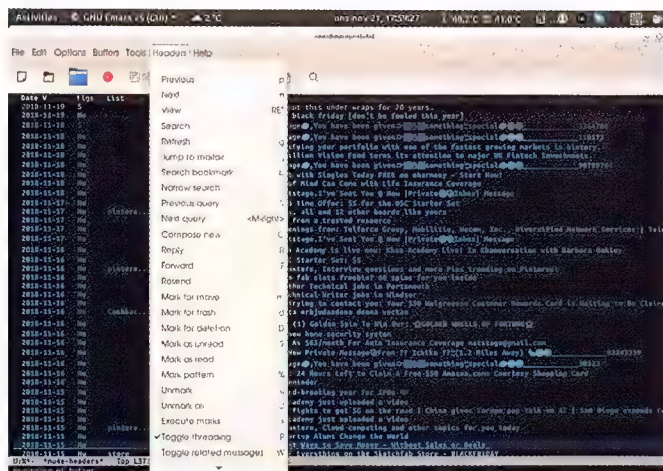
The template takes the headline of your email and creates the to-do item with those values and sets the current date. When you enter the agenda in *org-mode* you can then tweak the values the same way as when you're editing it directly.

TWITTER IN EMACS

You can also tweet from *Emacs*. At first glance, it seems complicated but the designer has made a great job in paving the way for you. The package is *twittering-mode* and is available on MELPA. The install is the usual *package-install* or use the package list and type I next to it and x to execute.

The next issue that's fantastically simple is authorisation. The first time you run *Twitter*, it takes you directly to the *Twitter* front page where you log in as usual and then get a PIN code. You return to *Emacs* and type in the PIN and you're immediately in your timeline.

In your timeline view, you use some of



While in headers mode you have all the functions available in a drop-down menu if you're using XEmacs. This can be turned off, though.

There's help available for beginners. Use C-h to display local help in the lower part of the screen.

the common keys to move around. Pressing J goes to the next tweet, K to the previous, while P takes you to the next tweet of the same author.

Tweeting, replying and retweeting is also supported. Press U for a spontaneous tweet, and to interact with someone else's tweet go to that tweet and hit Enter. A new buffer shows up where you type your tweet. C-c C-c sends and you can also cancel after you've started. You'll probably write a few tweets by mistakes while getting the hang of it so delete your own tweets with C-c D. To pick a timeline, press V and type in your hashtag.

Video editing in a text editor sounds bizarre, but it's definitely possible. The *GNEVE* package enables you to edit your video in EDL mode. It's supported by the MLT framework, which *Shotcut* also uses. The editing process takes place with your video in the background with your notes for the timestamps on top. You can change this setting in the tool.

To set up the tools, put the *gneve.el* file in your load path and add the code to your configuration file. You need to have a Miracle Server running on port 5250. You access this server from www.mltframework.org, which redirects to Github. It also requires *Mplayer* for the playback. As soon as you have the server, start *gneve* with M-x *gneve-mode*. Find a file by pressing V.

While playing, you can play normally, skip forward by frame, by second or by five seconds. To prepare to edit you mark the start (E) and end (R) of a section through the video, after that you play the result (I) and check your work. The package is fine for removing bad takes and making the flow correct. But as the designers rightfully say, it needs support for transitions and so if you're serious about videos you'll need to use something else or add such functionality yourself.

BLOGGING WITH EMACS

Emacs has several modes to publish to

blogging platforms, and *org2blog* is a prominent one. Others have support for Jekyll and there are even several ones using *xml-rpc*. To blog with *Emacs*, you still need to use some patchy software, but it's far from complicated. The mode file is named *org2blog*, and it's suitable for blogs using Wordpress. This mode exists on MELPA, but look out for the instructions on GitHub so you don't trip over the *xml-rpc* bug. The install is otherwise the usual routine: you need to place the *org2blog* file in your load path and load it in your *init.el* file. In addition, find the *htmlize.el* file from GitHub and set that in your *init.el* file. The basic code is as follows:

```
(require 'auth-source) ;; or
nothing if already in the
load-path
(let (credentials)
  ;; only required if your
  auth file isn't already in the
  list of auth-sources
  (add-to-list 'auth-sources
    "~/netrc")
  (setq credentials (auth-
    source-user-and-password
    "myblog"))
  (setq org2blog/wp-blog-alist
    '(("wordpress"
      :url "https://
      username.wordpress.com/xmlrpc-
      php"
      :username (car
        credentials)
      :password (cadr
        credentials)
      :default-title "Hello
        World"
      :default-categories
        ("org2blog" "Emacs" "vimgolf")
      :tags-as-categories
        nil)
      ("Blog-o-matic"
      :url "http://
      username.server.com/xmlrpc.php"
      :username "admin"))))
```

The two entries in this list are for **wordpress.com** and a private server on your own domain. To secure your password, use *netrc* to store your passwords out of your *Emacs* configuration files. After that's set up you can start blogging. If you have special tastes, set your parameters with M-x *customize-group* *org2blog/wp*.

Get started by logging with M-x *org2blog/wp-login*. The function will read the list you defined earlier and enable you to pick one of the blogs to use.

Time for your first post. Using M-x *org2blog/wp-new-entry*, you make a list of tags and categories by using comma separation. You can also set post templates so that the date is set immediately and the post gets a standard title. Posting is a simple keystroke away: C-c M-p and after that, press p for publish, d for draft, D for page draft or P for post as a page.

This article has covered a lot of possibilities available with *Emacs* and this is just scratching the surface. With *elisp* available for adapting to web APIs, the uses of *Emacs* as a tool for your programming and other text-based activities are endless. *Emacs* won't always be the best tool for the job, but if you're already familiar with it, creating a mode to handle your requirements is usually straightforward. If you train yourself in *Emacs* you'll have a powerful tool for writing documents and blogs at your fingertips. You can even use it for communicating with the world in a more focused way than a full web-page ever could – no more distracting pop-ups!

Even if you're using other tools for development, it's worth knowing how to use *Emacs* since it's almost always available to you. If nothing else, use it as an organiser for your work and hobbies. This makes *Emacs* as relevant as ever. ■

Optimise your Pi for better performance

Christian Cawley presents his tips and tricks for squeezing as much juice out of your Raspberry Pi as possible.

Has your Raspberry Pi slowed down? It's a common problem – it doesn't matter which version of the Pi you're using, performance always suffers if the operating system isn't correctly configured. Using a lightweight operating system such as Raspbian Lite, DietPi, or piCore can help, but there's much more you can do. Performance boosts can be gained from overclocking, changing how RAM is used, and ditching bloatware, among other things.

POWER RANGERS

The wrong power supply can wreak havoc with your Raspberry Pi's performance. With insufficient power to deal with processing requirements, bottlenecks can occur, slowing the computer right down. Low power can also result in read/write issues, which in turn can damage the microSD card (more on that later). Then there's the usual end result of a frozen Raspberry Pi: pulling the power lead and rebooting.

To avoid this, you need to give the Raspberry Pi a reliable power supply. This means using a good-quality PSU (if not the official device) rather than a spare USB port on your PC, TV or power bar.

The official Raspberry Pi power adapter has 100-240V input, and 5.1V 2.5A output. If you're not using the official PSU, you should ensure that your supply matches this, and that the micro USB cable is of good quality, in working order, and fits the Raspberry Pi correctly.

SUPER-SIZE PI

Using Raspbian Lite or some other lightweight distro is a good option for a stripped-back experience, but if you're looking for a more feature-packed operating system, the standard Raspbian installation is your best option.

A full gigabyte of storage space can be freed up by removing unused tools such as LibreOffice, the Wolfram Engine, Minecraft and Sonic Pi. To benefit from this fully, however, you need to have the full capacity of the SD card. This means using the Expand

A correctly optimised Raspberry Pi will run like a bat out of hell, no Meatloaf required.



"Massive performance boosts can be enjoyed by your Raspberry Pi by overclocking the processor."

Filesystem option in the raspi-config tool, or the Raspberry Pi Configuration menu on the desktop. You'll find this on the System tab.

Removing what might be unfairly termed "bloatware" on Raspbian is easy. Open a Terminal prompt and type

```
sudo apt purge libreoffice*
sudo apt clean
sudo apt autoremove
```

This will remove LibreOffice from Raspbian. Replace the `libreoffice*` command with `wolfram-engine`, `minecraft-pi` and `sonic-pi` to remove those tools.

With these four options removed, you'll have the advantage of increased storage space on your Pi without having the limitations of a lite distro.

KILL JAVASCRIPT DEAD

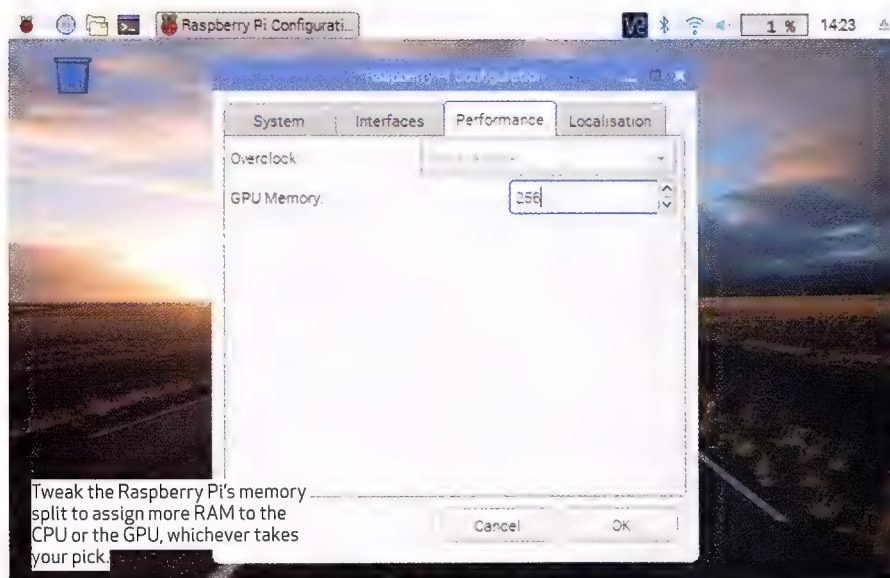
While it's wise to limit the number of tabs you have open in your preferred browser, further performance boosts can be gained by disabling JavaScript.

How you do this will vary. In Chromium, use Menu > Settings > Advanced > Privacy and security > Content settings > JavaScript. Here, switch Allowed to Blocked.

Disabling JavaScript can improve overall performance, as well as speed up some any pages that rely on it. While this might mean pages become less functional, it will also help to reduce the load on your Raspberry Pi from adverts and trackers. Note that exceptions can be added to your browser settings to allow JavaScript to run on specific sites.

UNDERCLOCK, OVERCLOCK, PI-CLOCKING'S FREE

Massive performance boosts can be enjoyed by your Raspberry Pi by overclocking the processor. Raspbian offers this as a built-in feature that can be found in the raspi-config tool (other distros may require additional software). Access the overclocking tool by selecting Overclock on the main raspi-config menu. Depending on



your Raspberry Pi model, you'll have several options here. The default option is None, with the clock running at the basic 700MHz, but you could ramp things up to 1000MHz and above with Turbo mode.

Using the overclocking menu means you can avoid having to worry too much about stress testing as the values on offer have already been tested. However, Turbo mode might cause problems, so it's a good idea to use a cooling solution (see Quick Tip, right).

With a Raspberry Pi 3 and above, you can also edit the `config.txt` file in nano to specify values for the four overclock settings: `arm_freq`, `core_freq`, `sdram_freq`, and `over_voltage`. The usual overclocking rules of taking a baseline reading and increasing incrementally apply.

The benefits of overclocking your Raspberry Pi include increased performance for video decoding in Kodi or playing more games from the fifth and sixth generation consoles that can currently be emulated on the Pi. Emulation of Windows apps with the ExaGear software is also improved.

DITCH THE CHEAPO SD CARD

Finding the right microSD card for your Raspberry Pi can be tricky, but with the right capacity and speed it can make a huge difference to how your Pi runs.

The secret here is to stick to named brands such as SanDisk, Samsung and Kingston, while keeping an eye on the card's speed and rating. A higher rating indicates better speed and error correction, which will improve your Pi's performance.

Once you've added a quality SD card, it's time to start looking after it. By now you should know how to correctly shutdown a Raspberry Pi.

Doing so will prolong the lifespan of the SD card, saving you further outlay (however inexpensive a replacement might be) and the fuss of setting up your Pi again from scratch.

From the desktop environment, be sure to shutdown from the main menu. If you're using a Kodi media centre distribution or a retro gaming suite, take the time to find the shutdown option and use this.

If it's quicker, or you're connected to your Pi over SSH, it's easier to shut down from the shell:

```
sudo shutdown -h now
```

You can also schedule a time to shut down the Pi:

```
sudo shutdown -h 02:46
```

An orderly shutdown will ensure your SD card's integrity is maintained, as well as avoid data loss.

ZIPPY ZRAM

RAM configuration options for the Raspberry Pi mean that you can easily designate a portion of RAM to the GPU

if necessary or reserve it for non-graphics tasks.

Using the Advanced Options sub-menu in raspi-config, find the Memory Split option and use this to specify how much memory the GPU should have. For example, if you're not using a desktop environment, then you can set this to 16MB, allowing the Raspberry Pi's processor to benefit from extra memory. For graphic-intensive tasks, however, your GPU will need more of the RAM. Note that even with a Raspberry Pi 3 B+ (which has 1GB of RAM), you'll be unable to assign more than 256MB to the GPU.

Perhaps the best performance tweak for the Raspberry Pi can be made to the RAM, utilising unused space for swap data.

As explained by YouTuber NovaSpirit Tech, ZRAM can be used as a swap disk. While the data won't persist following a reboot, this can speed up your Raspberry Pi up considerably.

Begin by grabbing the script from GitHub:

```
sudo wget -O /usr/bin/zram.sh https://raw.githubusercontent.com/novaspirit/rpi_zram/master/zram.sh
```

Next, make the file executable and edit `rc.local` to run the script when you reboot:

```
sudo chmod +x /usr/bin/zram.sh
```

```
sudo nano /etc/rc.local
```

Look for the exit 0 line, and above it add:

```
/usr/bin/zram.sh &
```

Hit Ctrl+X to save and exit the file. ZRAM swapping is far faster than relying on even the fastest microSD card, with an instant performance boost. ■

Don't push your Pi

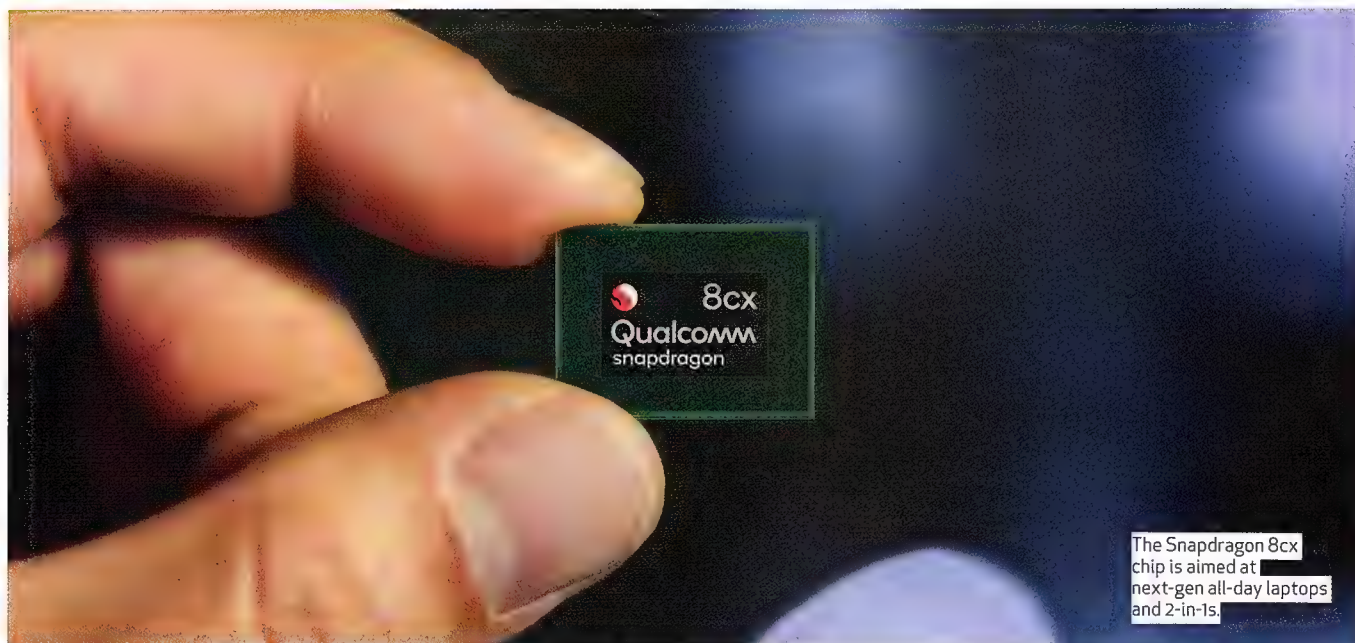
As versatile as the Raspberry Pi is, it's a good idea to be certain that it's the right device for the project you have in mind.

You might just be using the Raspberry Pi for retro gaming or Kodi. It might be acting as a desktop replacement, or as the main component of an IoT project. If your Raspberry Pi is up to the task, then it should work fine. The problem is when you choose a task that the Pi just can't do, even when the hardware appears to be a good fit.

Conversely, the Raspberry Pi might be far too advanced for the task you have in mind, such as flashing an LED over the web, or something equally low-spec.

Perhaps there isn't quite enough RAM; or maybe the issue is with the ARM architecture. Whatever the problem, all the configuration tweaks and tricks in the world won't help if the hardware can't handle the project.

Even the Raspberry Pi 3 B+ isn't powerful enough for some situations. So, what's the alternative? Well, you could look at some of the Pi's nearest rivals, such as the Asus Tinker Board, Pine64, or even Odroid-XU4. Rather than trying to do everything with the Raspberry Pi, choose the right device for the job.



2019 Mobile CPU Roadmap

New 5G phones arrive this year, but what else will next-gen mobile devices do? Darren Yates digs under the bonnet and finds the answers – inside the CPU chips.

We always say it, but if you want to know what's coming inside your next-generation phone, look at new-generation CPU tech. While there's plenty of hype (and, for big phone makers, hope) surrounding the arrival of 5G, the new mobile CPU technology launching this year will have far greater reach than just your mobile phone. In fact, the CPU tech about to power your new phone soon could be running your laptop, driving your car and flying your plane.

PEAK SMARTPHONE?

Have we reached 'peak smartphone'? That's the question now being asked by some pundits after news of Apple's slowing iPhone sales sent shockwaves

around investment circles in late-2018. It also coincided with market research from Gartner that if it wasn't for Chinese brands Huawei and Xiaomi, third-quarter 2018 global phone sales would've dropped more than 5% on the same point in 2017. Samsung sales fell 14% during the period, with Gartner pointing the finger at the Galaxy S9 and Note9 devices.

However, given the rocketing growth put on during the same 2018 period by Huawei (43%) and Xiaomi (23%), it's probably more accurate to say we've just reached 'peak 4G premium phone prices'. It's also why there'll be plenty riding on next-gen 5G phones.

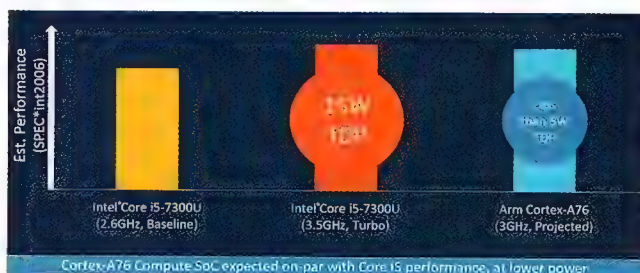
ARM CORTEX-A76

The CPU tech at the forefront of many

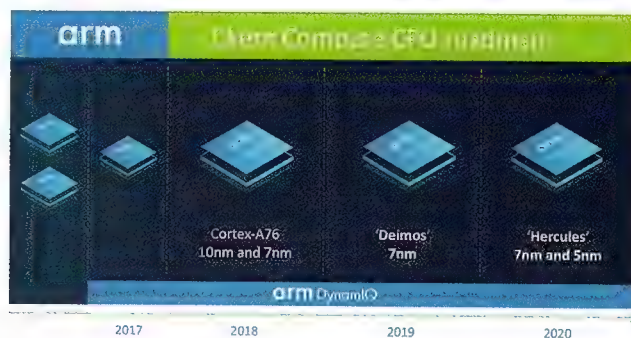
2019 flagship devices will be the new Cortex-A76. ARM Holdings is the company that designs the Cortex-A series CPU tech powering the overwhelming majority of phones, tablets and TVs, but instead of making the chips itself, it licenses the tech to other brands to manufacture.

Over the last few generations, ARM has been snapping at the heels of chip giant Intel for mobile performance, but the company is now claiming the new Cortex-A76 running at 3GHz will outgun Intel's 2.6GHz i5-7300U chip for baseline performance and almost match its 3.5GHz 'turbo' speed, all on only a third of the electrical power. In terms of size, the A76 is designed to be manufactured at 7-nanometre (nm)-scale, which is a big deal in itself,

Cortex-A76 laptop-class performance comparison



ARM reckons the Cortex-A76 will give Intel's Core i5-7300U some stick.



Hercules is ARM's next chart-topper CPU scaled for 5-nanometre production.

particularly given the difficulty Intel has had shrinking its Core CPUs down to 10nm. ARM will push the envelope even further in 2020, with the launch of 'Hercules', a high-performance CPU core designed for manufacture at a tiny 5nm scale.

While phones will see the Cortex-A76 later this year, the level of performance on offer has ARM seeking bigger game. Windows 10 laptops based on ARM-grade CPU tech are starting to hit their mojo, offering 20-hour plus battery life and passable performance. Expect newer, faster 2-in-1s and laptops based on the Cortex-A76 later this year.

QUALCOMM SNAPDRAGON 855

If you're looking specifically for your next phone hit, the Snapdragon 855 SoC (System on a Chip) from chip maker Qualcomm will drive a number of big-name flagship models over the next six months. The 855 is unusual in that it's a 1+3+4 CPU design – four small efficient Cortex-A55 cores running at 1.8GHz, three larger cores based on the Cortex-A76 running at 2.42GHz, plus a single A76 core we're dubbing 'corezilla' clocking in at 2.84GHz. Adreno 640 GPU, ability to capture 4K video at 60fps and playback 8K video, it's impressive.

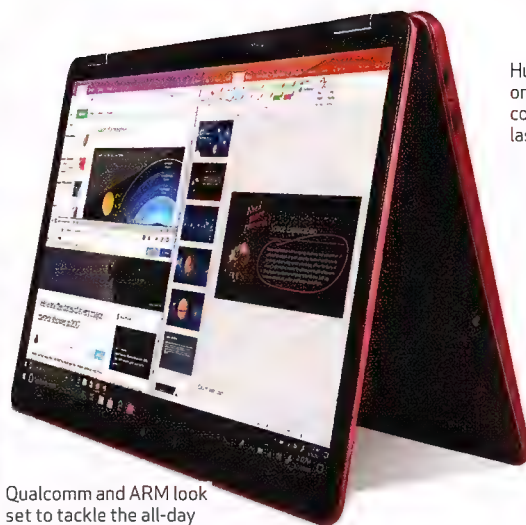
However, while the Snapdragon 855 platform is marketed as having '5G' capability, it's not a guarantee every Snapdragon 855 device will be 5G-ready. The 855 supports two Qualcomm modems, the Snapdragon X24 and X50. The X50 is the genuine '5G' modem, whereas the X24 is the first LTE Category 20 (4G) modem, with a top download speed of 2Gbps, so while it's damn fast, it's 4G nonetheless. Still, to put it into perspective, the X24 at full download speed is enough to destroy a 25GB download plan in under two minutes (the trick is finding a network and location that fast).

Lenovo and Samsung look like duking it out to launch the first SD855 phones – Lenovo with its Z5 Pro GT (and 12GB of RAM), followed by Samsung and its Galaxy S10. Both should be around by the time you read this.

QUALCOMM SNAPDRAGON 8CX

Just before Christmas, Qualcomm also announced a new 'Snapdragon 8cx' SoC platform, combining an eight-core Kryo 495 CPU and Adreno 680 GPU. However, with the X24 LTE modem again bundled inside, it's not 5G, although as we mentioned earlier, 2Gbps isn't exactly slow either.

The 8cx is similar to the Snapdragon 855 with four A53 and four A76 cores, but the 8cx features 10MB of combined L2/L3 cache, twice that of Snapdragon 855 and better suited to heavy OS/application workloads. Again, expect the Snapdragon 8cx to go toe-to-toe



Qualcomm and ARM look set to tackle the all-day laptop market.

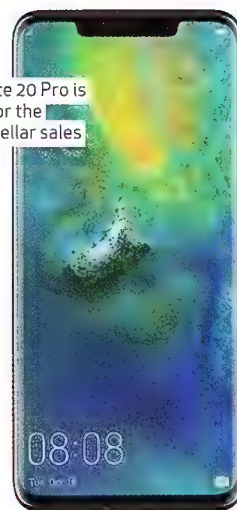
with Intel's Core i5-U CPU series in the 2-in-1 and all-day laptop market.

SAFETY-LOCK CPUS FOR CARS, AVIATION

Consumer-grade computing devices are a huge market, no question, but mobile CPU makers are increasingly looking towards lucrative transport industries to grow their market-share. For starters, the ARM Cortex-A76 has a cousin – the Cortex-A76AE. The 'AE' stands for 'Automotive Enhanced' and in the case of the A76AE, safety-critical automotive applications are the focus, such as advanced driver-assistance systems (ADAS) and autonomous driving applications.

One of its key features is what ARM calls 'dual-core lock-step' (DCLS) mode – and it works a bit like a two-drive RAID 1 array. When switched, it sets two CPU cores to run in lock-step – whatever one is doing, the other does too – ensuring that if one core fails, the other core continues without missing a computational beat. It's designed to meet Automotive Safety Integrity Level (ASIL) D standards, currently the highest automotive safety level available. The two cores can be switched between 'split' mode, offering

Huawei's Mate 20 Pro is one reason for the company's stellar sales last year.



maximum performance, and this 'lock' redundancy mode. Another application for dual-lock is aviation – in fact, ARM is aiming the Cortex-A76AE and its Cortex-A65AE sibling, both of which have split-lock functionality, into aviation applications.

The Cortex-A65AE is also ARM's first symmetrical multi-threaded (SMT) core design. Like its A76AE sibling, each core can process two instructions at the same time. It's unlikely you'll find it in a phone any time soon, but for handling multi-sensor data pinging in on the average autonomous vehicle, it's far more suited.

CPU DETERMINES THE REST

The recent Consumer Electronics Show (CES) in Las Vegas revealed plenty of eye-popping tech advances from large-screen roll-up TVs to phones with flexible screens. However, as impressive as this tech is, the humble SoC is still the yardstick for determining what a device can do. Everything from battery life, screen resolution, camera functionality and download speeds to gaming capacity, artificial intelligence and battery charge speeds are set by the SoC. If you want to maximise the budget buying your next phone, make sure you know your SoCs. ■

Introducing the Qualcomm®

QTM052 5G mmWave antenna module

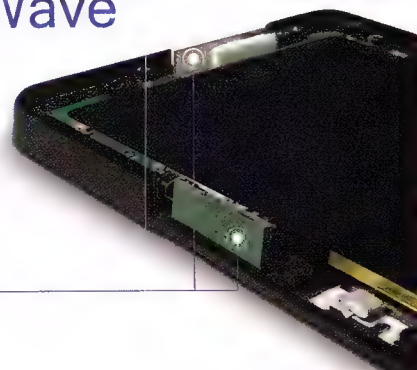
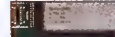
Expands portfolio of fully-integrated 5G NR mmWave modules for mobile devices



Size scale

Previous

New



The QTM052 is the radio module for Qualcomm-powered 5G-ready phones.

Python for Machine-Learning Part 1: Introduction

In this new series, Darren Yates dives into the Python programming language and how to use it in machine-learning and data-mining applications.

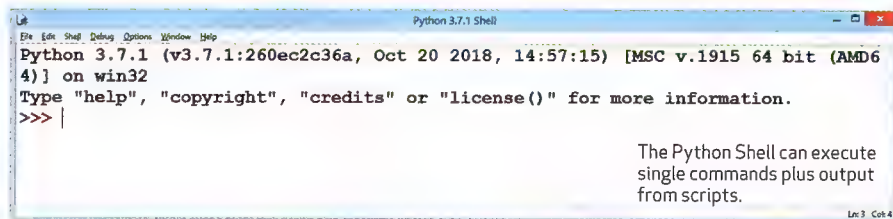
Look at almost any survey searching for the world's most popular programming language and more often than not, it's Python that takes the cake. It's one of the easiest languages to learn and taught to school kids around the world. It runs on almost any computing device, from your PC to your Android phone and even microcontroller boards like the BBC micro:bit (which I highly recommend, by the way). Plus, Python is modular, meaning you can add in new functions at-will through a vast set of plug-ins or 'libraries' for a wide range of applications – or even code your own. One of the most popular applications for Python is machine-learning and over the course of this new series, we'll work through the Python language, with particular reference to machine-learning and data-mining. We'll learn by doing and wherever possible, we'll use free, open-source software, so let's get cracking and set things up.

GRAB THE SOFTWARE

Unless we specify otherwise, all you'll need is the Python programming language – you can download the latest version 3.7 for free from python.org/downloads. It runs on Windows, macOS and Linux (all flavours). The Windows and macOS versions are available with their own easy-to-use installers; the Linux versions from the Python.org website however comes as source code that you need to compile. In many cases, it's easier to just install the latest version available from your distro's file repository. Many Linux distros have a version of Python 3 built in, but you can generally install the latest available version from the repository, for example, users of most Debian-based distros (Linux Mint, Ubuntu, Xubuntu etc) can run the following at a terminal prompt:

```
sudo apt-get install
python3.6 python3-pip idle-
python3.6
```

We recommend using at least the latest version of Python 3.6 (3.6.8 at time of writing), but either version 3.6



The Python Shell can execute single commands plus output from scripts.



"The easiest way to code your own programs or 'scripts' is to use Python's own bundled integrated development environment (IDE) called 'IDLE'."

or 3.7 will be fine. For simplicity, we'll use the Windows version of Python, but everything we do, including the source code we write, should work equally as well on the macOS and Linux versions.

LAUNCHING IDLE

The easiest way to code your own programs or 'scripts' is to use Python's own bundled integrated development environment (IDE) called 'IDLE'. Use the Windows shortcut for IDLE and you'll actually see the Python Shell, which is where the output of your programs (we'll use the Python term 'scripts' from now on) appear. To bring up the IDLE code editor, go to the Python Shell and from the menu, select File, New File and a new code editor window will appear. You can type individual Python commands into the Python Shell prompt (>>) and execute them by pressing the Enter key, but the IDLE editor is where you write complete scripts as well as save them to and load them from disk.

BY THE WAY, DON'T PANIC!

A lot of the basics of coding are pretty simple and you shouldn't have too much trouble picking them up – but as

Truth Table for Three ANDed Condition Statements

Cond1	Cond2	Cond3	Result
FALSE	FALSE	FALSE	FALSE
FALSE	FALSE	TRUE	FALSE
FALSE	TRUE	FALSE	FALSE
FALSE	TRUE	TRUE	FALSE
TRUE	FALSE	FALSE	FALSE
TRUE	FALSE	TRUE	FALSE
TRUE	TRUE	FALSE	FALSE
TRUE	TRUE	TRUE	TRUE

The output of three ANDed condition statements is true only if all are true.

always, it's much easier to learn to code if you actually do it, rather than just read about it. In fact, I've heard a few uni lecturers who teach coding agree that the most difficult thing for newbies to get over is the fear of making mistakes. News flash: everyone makes coding errors. They're so common, they even come in three distinct flavours – syntax, runtime and logic. Syntax errors are usually mistypings or misspellings of keywords or code, runtime errors occur when your code can't execute a command and logic errors (by far the most annoying) are your code working,

but not doing what you expected. The point is if you're fairly new to coding, don't panic about making errors – just like almost everything else, you get better at coding by doing it.

VARIABLES

Each one of us drips with data. Think about it – without lifting a finger, you have a name, an age, a gender, marital status, Medicare number and address. If you've ever had a job, you also have a tax file number. If you've ever been in hospital, you'll likely have had readings taken for heart rate, blood pressure, blood glucose level, possibly blood type. However, interact with the digital world and watch the data flow like a river – bank accounts, credit cards, phone numbers, driver's licence, bank loans, mortgage, loyalty card programs, social media accounts and the list goes on and on and on.

Machine-learning and programming are all about data. You can store data temporarily in your scripts using 'variables'. The easiest way to think of a variable is as a bucket. A single bucket usually carries one type of substance – water, dirt, Lego bricks, whatever. In coding, our basic 'bucket' carries one piece of data. For example, say we wanted to store your age to use in a script. We can create a variable called 'age' and assign the number value of your age to it like this:

```
age = 38
```

The equals sign (=) here means 'assign', so the value of whatever is on the right-side of the equals sign is assigned to the variable name on the left. We've assigned the number '38', but it could also be the value of an equation, such as:

```
price = 35.50 * 1.1
```

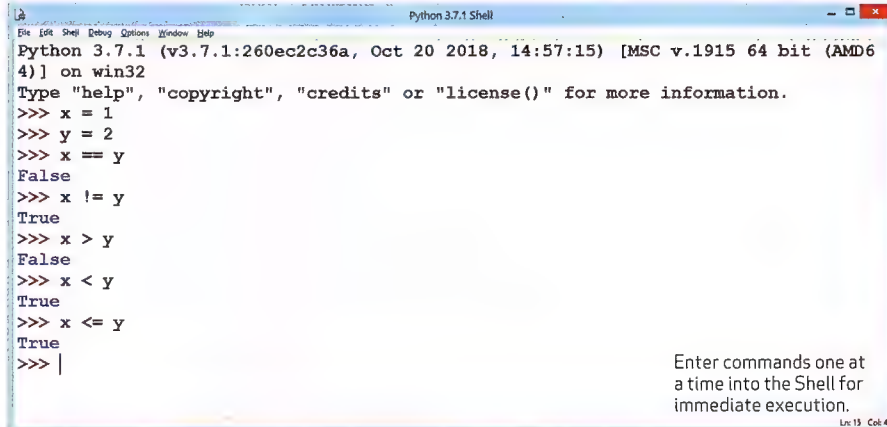
Python firsts calculates 35.5×1.1 on the right-side, then assigns the result of that equation to the variable 'price'. But it's not just numbers you can assign to variables – you can assign text characters, for example:

```
first_name = 'John'
last_name = 'Smith'
```

You can also assign a 'Boolean' value to a variable. Boolean values are 'true' or 'false', so named for 19th-century mathematician George Boole. You can use them like this:

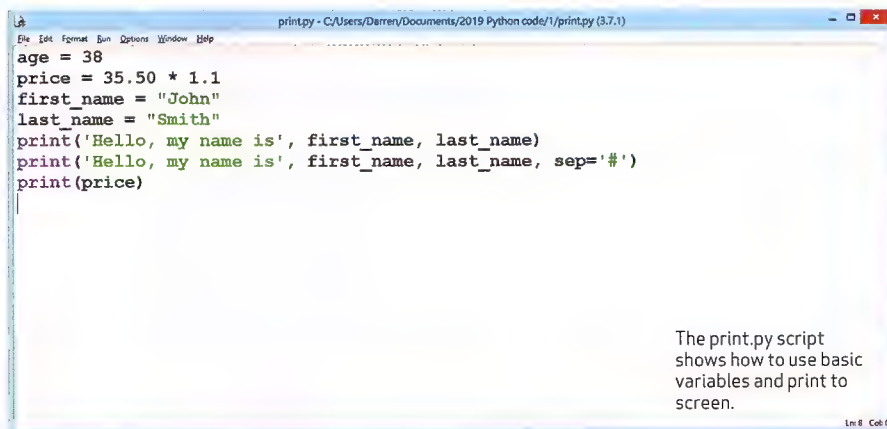
```
loves_hotchips = true
drives_ferrari = false
```

The thing to remember is that the variable name has to be on the left-side of the equals sign, the value



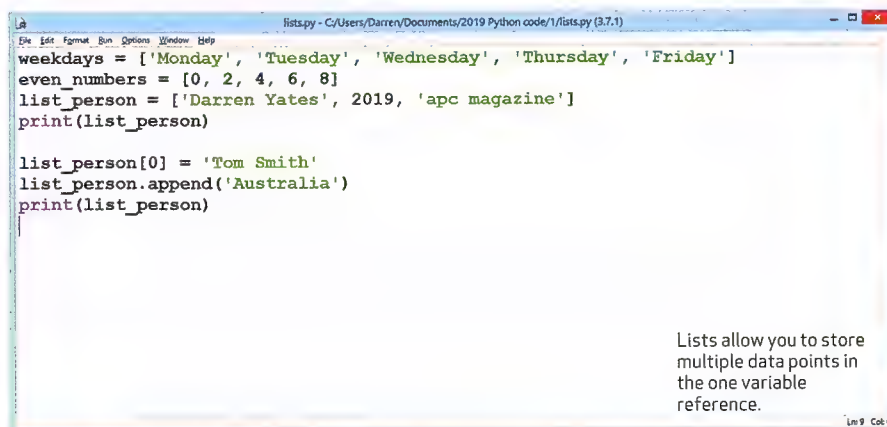
```
Python 3.7.1 Shell
Python 3.7.1 (v3.7.1:260ec2c36a, Oct 20 2018, 14:57:15) [MSC v.1915 64 bit (AMD64)] on win32
Type "help", "copyright", "credits" or "license()" for more information.
>>> x = 1
>>> y = 2
>>> x == y
False
>>> x != y
True
>>> x > y
False
>>> x < y
True
>>> x <= y
True
>>> |
```

Enter commands one at a time into the Shell for immediate execution.



```
print.py - C:/Users/Darren/Documents/2019 Python code/1/print.py (3.7.1)
age = 38
price = 35.50 * 1.1
first_name = "John"
last_name = "Smith"
print('Hello, my name is', first_name, last_name)
print('Hello, my name is', first_name, last_name, sep='#')
print(price)
```

The print.py script shows how to use basic variables and print to screen.



```
lists.py - C:/Users/Darren/Documents/2019 Python code/1/lists.py (3.7.1)
weekdays = ['Monday', 'Tuesday', 'Wednesday', 'Thursday', 'Friday']
even_numbers = [0, 2, 4, 6, 8]
list_person = ['Darren Yates', 2019, 'apc magazine']
print(list_person)

list_person[0] = 'Tom Smith'
list_person.append('Australia')
print(list_person)
```

Lists allow you to store multiple data points in the one variable reference.

of whatever you want stored on the right.

OUTPUT

Still, this isn't all that useful if you can't see any of it. The simplest way to output the data so it can be seen is to send it to the screen. That's what the print() function does:

```
print('Hello, my name is',
first_name, last_name)
```

Notice the commas – a comma inside quotation marks is a string character and gets displayed; a comma outside acts as a separator between strings, numbers and variables. For example, run the above print() command with the variable values shown previously and you'll get:

Hello, my name is John Smith

Note, too, the spaces between the 'is', 'John' and 'Smith' – these are placed by default. You can change this by adding the 'sep' parameter after the last variable. For example:

```
print('Hello, my name is',
first_name, last_name,
sep='#')
```

will give you:

Hello, my name is#John#Smith

If you have any experience with Python, this should all be pretty straightforward. If not, play around with it until you get the hang of it.


```

#----- Change the number to change the level -----
current_water_level = 20
#----- Change the number to change the level -----
minimum_water_level = 100

# Version 1
print('\nVersion 1:')

if (current_water_level > minimum_water_level):
    print("Water level is good, boiling the jug now...")
else:
    print("Water level too low, filling the jug now...")
    print("Water level is good, boiling the jug now...")

# Version 2
print('\nVersion 2:')

if (current_water_level < minimum_water_level):
    print("Water level too low, filling the jug now...")
    print("Water level is good, boiling the jug now...")

```

If-statements allow you to control and direct the flow of your scripts.

```

# ----- Changes these values -----
temp = 42
wind = 54
humidity = 15
# ----- Changes these values -----

# Version 1
print('Version 1:')

if (temp > 40):
    if (wind > 50):
        if (humidity < 20):
            fire_danger = 'not_too_good'
            print('The fire danger rating is:', fire_danger)

# Version 2
print('\nVersion 2:')

if (temp > 40 and wind > 50 and humidity < 20):
    fire_danger = 'not_too_good'
else:
    fire_danger = 'could_be_worse'
print('The fire danger rating is:', fire_danger)

```

Logical and relational operators are key to making if-statements work.

element of a list is always zero). You can append a new element to the end of a list using the 'append()' function:

```
list_person.append('Australia')
```

Print the list again and you get:

```
['Tom Smith', 2019, 'apc magazine', 'Australia']
```

There are other more complex data structures you can create, but for now, just get a feel for the versatility of how lists work.

IF THIS THEN THAT

What really makes coding work is being able to redirect or control your code depending on a conditional situation, usually a value or value range of one or more variables. If it sounds complicated, try an easy analogy – say you're about to make a cuppa. First, you check to see if there's enough water in the jug. If there is, you turn on the power and let the jug boil. If there's not, you fill the jug first, then boil it. We could write this action in Python code as:

```

if (current_water_level >
minimum_water_level):
    boil_jug()
else:
    fill_jug()
    boil_jug()

```

In Python, this is called an 'if-else' statement. Inside the 'if' brackets () is the condition that is evaluated. A condition always evaluates to either true or false and in this case, we want to know if the current_water_level is greater than (>) the minimum_water_level. If it is – in other words, the condition in the brackets is true – we run the code that immediately follows the first colon ':' – in this case, the 'boil_jug()' command. Otherwise (that is, if the condition is false), we drop down to the 'else:' code block and first run the 'fill_jug()' function, followed by the 'boil_jug()' function.

Another thing to note here is the line indentation. Python uses line indents to section the code. In this case, the first 'boil_jug()' command belongs to the if-clause codeblock and only runs if the condition statement is true. You use the tab key to create an indent.

Finally, as you get more practised at coding, you'll likely find ways to make your code more efficient. In this example, we run the 'boil_jug()' function whether the if-clause condition is true or not – it appears in the if-codeblock as well as the else-codeblock. We can rewrite this if-statement more efficiently as:

```
if (current_water_level <
```

"What really makes coding work is being able to redirect or control your code depending on a conditional situation, usually a value or value range of one or more variables."

LISTS

A more useful data structure from a statistical viewpoint is a list. Lists not only allow you to store multiple points of data in the one variable, but you can access them numerically by an index, like flats in a building. Creating or 'initialising' a list is easy, too:

```

weekdays = ['Monday',
'Tuesday', 'Wednesday',
'Thursday', 'Friday']
even_numbers = [0, 2, 4, 6,
8]
list_person = ['Darren
Yates', 2019, 'apc magazine']

```

Lists are enclosed by square

brackets [] and can contain strings, numbers, Boolean values – or a mixture of all three. You can also add to lists and change them – they are 'mutable'. For example, we can change an element in a list by using its index:

```
list_person[0] = 'Tom Smith'
```

Print the list using 'print(record)' and you'll see on the screen:

```
['Tom Smith', 2019, 'apc magazine']
```

We've replaced element [0] in list_person, which was 'Darren Yates', with 'Tom Smith' (the index of the first

Comments are shown in red and not executed.

Orange is used for commands

purple is used for functions

IDLE colour codes your scripts to make it easy to identify various sections.

```
File Edit Format Run Options Window Help
#----- Change the number to change the level -----
current_water_level = 20
#----- Change the number to change the level -----
minimum_water_level = 100

# Version 1
print('\nVersion 1:')

if (current_water_level > minimum_water_level):
    print("Water level is good, boiling the jug now...")
else:
    print("Water level too low, filling the jug now...")
    print("Water level is good, boiling the jug now...")

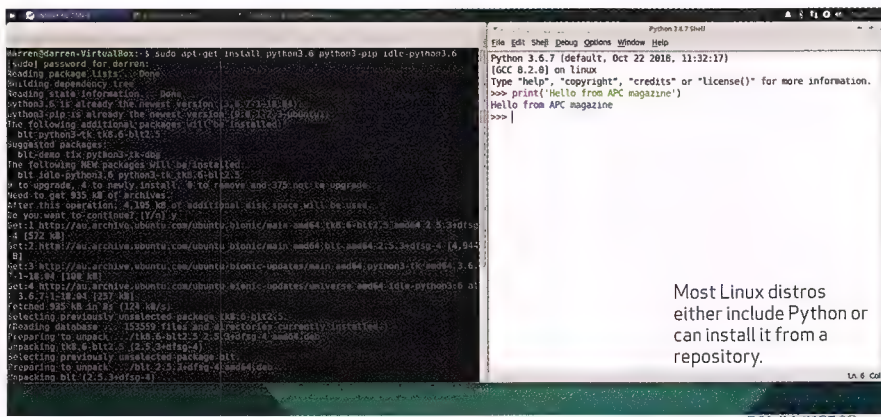
# Version 2
print('\nVersion 2:')

if (current_water_level < minimum_water_level):
    print("Water level too low, filling the jug now...")
    print("Water level is good, boiling the jug now...")
```

black is used for variables, literal values and standard general syntax.

Strings of text are shown in green.

IDLE Code Editor Colour Coding



Most Linux distros either include Python or can install it from a repository.

```
minimum_water_level):
    fill_jug()
    boil_jug()
```

Note that the `boil_jug()` function here is not indented – that means it's not part of the if-statement and will run regardless. So effectively, we're now saying that if the current water level is less than (<) the minimum level, fill the jug, but in any case, boil the jug. We get the same result as before, but with only three lines of code instead of five.

COMPARISON OPERATORS

The greater-than (>) and less-than (<) symbols used above are two of six comparison or 'relational' operators you can use in if-else statements. These six are:

```
<    is-less-than
>    is-greater-than
==   is-equal-to
!=   is-not-equal-to
>=  is-greater-than-or-
equal-to
```

```
<=   is-less-than-or-equal-
to
```

The double-equal sign here for 'is-equal-to' is so that it isn't confused with the single equals sign for assigning values to variables. With these six operators, you can create a whole range of comparisons.

LOGICAL OPERATORS

Each of the six comparison operators allows you to compare two values or variables – but what if you have more? For example, say you want to compare temperature, wind speed and humidity to determine a simple bushfire danger rating. Rather than trying to combine three separate if-statements, one for each variable, we can combine the three into one with the addition of logical operators:

```
if (temp > 40 and wind > 50
    and humidity < 20):
    fire_danger = 'pretty_awful'
```

Here, if all three conditions are true

– temp is greater than 40, wind greater than 50 and humidity less than 20 – the fire_danger value is set to the calibrated-to-Australian-conditions rating of 'pretty_awful'.

There are three logical operators – 'and', 'or' and 'not'. We won't go into detail here, but you can combine them in all manner of ways. However, the key thing is when used in the condition of an if-statement, the whole condition must be true for the if-section codeblock to execute; otherwise, if the whole condition is false, the else-section code runs instead (the truth table for using three ANDed conditions explains how it works).

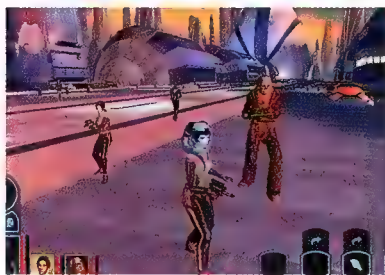
WALK BEFORE YOU CAN RUN

If you can't code, it makes machine-learning all that more difficult, so it's important for us to cover the Python basics first, just so we're all on the same page (no pun intended). If you've never coded in Python before and just stopped by, why not have a go? Download our Python Part 1 source code pack from the www.apcmag.com/magstuff website, unzip it and load the files one at a time into the IDLE editor and give them a run. Python files are just plain text files with a '.py' suffix. The magic happens when you press the <F5> function key – this launches the Python interpreter (the Python coding engine) to run the script in the file.

While you're at it, muck around with the files – change the code, swap code lines around, see what happens. I can't stress enough how important it is you learn to code by coding. Hopefully, it's not as scary as you might have thought. We'll continue next time. ■

downtime

GAME NEWS IS SERIOUS NEWS.



BioWare has reportedly tried (and failed) to revive *Knights of the Old Republic* multiple times

BIOWARE APPARENTLY WANTS TO MAKE IT HAPPEN, BUT IS HAVING "NO LUCK".

According to Jason Schreier, BioWare has repeatedly attempted to revive its revered *Star Wars* game series under EA, but have had "no luck" in doing so, though it's unclear as to why. "They've tried to make it happen", said Schreier, "more than once from what I've heard", but he didn't divulge any further details about the situation.



In-game *Fortnite* concert attracted 10 million viewers

EPIC GAMES' BATTLE ROYALE PUTS ON AN EVENT LIKE NO OTHER.

The popular DJ Marshmello played a ten minute show in *Fortnite* last month, attracting ten million in-game viewers across thousands of servers. The event, which took place in the game's battle royale map, saw weapons temporarily disabled, a light show, and an abundance of fireworks. Given its success, expect to see plenty more in-game cross-promotions in the future.



Epic Games Store starts to alarm Valve

The season's biggest shooter, *Metro Exodus*, has abandoned Steam in favour of Epic's new shopfront.

First-person shooter *Metro Exodus* launched exclusively for the Epic Games Store in February, after its publisher Deep Silver opted to remove it from Steam in favour of the newer platform. The move wasn't without its complications: pre-orders already placed on Steam will still be honoured, meaning the game will exist in a diminished fashion on Valve's service until February next year – when Epic's timed-exclusive period ends.

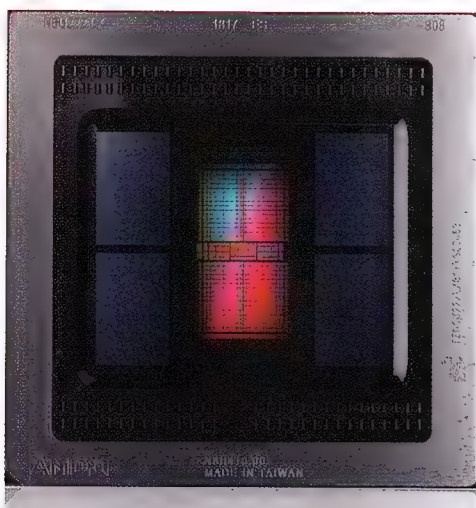
The move must have rattled Valve, because the traditionally quiet company was compelled to address the matter in a statement. "We think the decision to remove the game is unfair to Steam customers," the company wrote, "especially after a long pre-sale period." The statement goes on to add that Valve was "only recently informed of the decision and given limited time to let everyone know."

Apple is reportedly moving into the games subscription space

A NETFLIX-STYLE MONTHLY PAYMENT SERVICE IS STILL IN EARLY DISCUSSIONS.

Apple has reportedly been planning a games subscription service, styled after Netflix and possibly similar to Xbox Games Pass and PlayStation Now. The rumour comes via Cheddar, which claims that five people "familiar with the matter" have corroborated the report. According to that website, the company is still in the early stages of planning and may choose to abandon the project, though it has raised the matter with game developers already, with two sources claiming Apple has ambitions to start publishing titles.

Apple has traditionally been aloof to gaming, despite the proliferation of games on its App Store platform for iPhone and iPad. Its most direct gambit in this direction came in the form of Apple TV, which supported games but wasn't a raging success. But with the success of modular portable devices like the Nintendo Switch and the blossoming games subscription model, the company is well positioned to make a move.



AMD Radeon VII GPU to support DLSS-like cloud AA

We too can do cloud-based rendering, says AMD's Lisa Su.

Nvidia's Turing GPU brought support for DLSS, a new and proprietary cloud-based neural learning process that analyses your games and, over time improves the anti-aliasing performance. It does this by building up a vast database of game scenes on Nvidia servers, and in theory at least, sending AA instructions down the internet to your PC gaming screen in real time, which not only improves AA fidelity, but also alleviates the load on your GPU.

Nvidia's DLSS only works with the new Turing GPU because it leverages its new Tensor cores, which aren't present in earlier GPU generations. AMD, on the other hand, will be looking to DirectML, which is a Microsoft-developed API that is part of DirectX12. The API isn't due for public release until later this year.

Both DLSS and DirectML work by supersampling the image on screen, with the heavy lifting done by servers, while your PC's GPU renders the scene at a lower resolution thereby easing the load, and, if it all works perfectly, creating sharp anti-aliased similar to 4k, but rendered at a lower resolution locally to allow better performance.

"Your PC's GPU renders the scene at a lower resolution thereby easing the load, and, if it all works perfectly, creating sharp anti-aliased similar to 4k."

Fallout 76's new Survival mode will take the gloves off PvP

... AND IT'S GETTING A BETA THIS MARCH.

Bethesda finally outlined the new *Fallout 76* PvP experience it's been hinting at for weeks. This new mode, Survival, will be a totally separate way to play the game, and while the full version is still a ways off, a beta is scheduled for March.

Basically, when you boot up *Fallout 76*, you'll choose between Adventure mode and Survival mode, and then play the game according to the rules of your choice. Adventure mode players and Survival mode players will never interact. Survival mode removes a lot of the restrictions on PvP and actively encourages killing other players.

You can play Survival mode with your current character or you can create a new one specifically for it. Bethesda advises that "all your progress from Adventure mode will travel with you, and anything that affects your character in one game mode will also affect them in the other," which includes, you know, bad stuff, like "all players, except your teammates or event group-mates, are automatically flagged as hostile toward one another by default."



Fortnite V-Bucks linked to large-scale money laundering

FORTNITE MONEY HAS BEEN USED TO PROCESS VERY REAL, VERY STOLEN MONEY.

According to a joint investigation from The Independent and cyber security firm Sixgill, *Fortnite*'s premium currency, V-Bucks, is being used to launder money. Simply put, criminals use stolen credit cards to buy V-Bucks, then resell the V-Bucks in order to launder or 'clean' their profits. This operation preys on "Epic Games' weak security measures," said Sixgill analyst Benjamin Preminger, and has been managed "with relative impunity."



Respawn unveils Apex Legends, a free-to-play battle royale

THE TITANFALL STUDIO WANTS A PIECE OF THE CHICKEN DINNER.

Respawn, the studio responsible for the *Titanfall* series, surprise-released a new free-to-play battle royale game last month in the form of *Apex Legends*. Released for PC, PS4 and Xbox One and set in the *Titanfall* universe, the game boasts 60 player servers and trio team formations. To coincide with the announcement, a spokesperson for Respawn confirmed that the studio is not currently working on a *Titanfall 3*. ■



\$89.96 | PC, PS4, X0 | WWW.JUSTCAUSE.SQUARE-ENIX-GAMES.COM

Just Cause 4

Just enough new hooks and tethers.

The *Just Cause* series has a knack for holding your attention in short bursts. It can cause you to grit your teeth as you wingsuit so close to mountains that you can taste the snow spray, and grapple-hook up to helicopters to escape the mushrooming flames of exploding bases. It also gives you the freedom to tether a goat to a balloon, hook yourself onto it and float off into the stratosphere.

This time the protagonist, Rico, is helping liberate the South American island of Solis, a vast paradise of several beautiful biomes whose people are oppressed. It's on you to wrest back control of the island. Where in previous games you did this simply by causing enough destruction in a given region, this time Avalanche has attempted

to inject a bit more depth into the process. Each region has a specific mission you must complete, and once you've done that you can call in squads of revolutionaries – unlocked by destroying enemy infrastructure and capturing certain regions – to take control of it. The whole map is open for you to explore from the start, but you can only move these squads into regions neighbouring those under your control, making that map-painting process a little more focused than before.

This macro-scale layer gives an appearance of strategy, with the numbers of squads in regions and frontline markers teasing the possibility of a kind of *Risk*-like territory game, but it never follows through. Head over to the frontlines and you'll see skirmishes between your squads and the enemy, but

it's all for show, as the enemy can't actually retake territory from you, and your side's progress is dictated solely by Rico's renegade activities.

Rico remains a weightless spiderman, retaining that joyous, nonsensical means of getting around that relies on well-timed sequences of grapple-hooking, parachuting and wingsuiting. It still feels breezy and liberating, though the novelty has faded for lack of any major improvements in this area. But maybe all that stuff is essentially a glorified Zimmer frame, because on the ground Rico seems stiff in the joints, with no ability to sprint, dodge, or perform melee attacks with any real menace. Guns lack weight and punchy sound effects, enemies are incorporeal and floaty, as

if half their insides have been replaced with helium, and driving remains awkward.

Just Cause 4 ups the excess just enough to get away with the fact that its groaning framework feels about one firm tether yank away from collapsing. It still delivers the kinds of uniquely gamey thrills that seem to have been serendipitously borne of gravity-defying glitches, but when the smoke finally clears and you regain your senses, the underlying shonkiness of the missions and the basic nuts-and-bolts are laid bare. ■

Robert Zak

Verdict

Still delivers the series' sandbox mayhem.





\$49.95 | PC, PS4, XBOX ONE | WWW.MUTANTYEARZERO.COM

Mutant Year Zero: Road to Eden

Mutants add spice to the Xcom-alike sub-genre.

Here's the basic idea: the world is divided into lots of discrete but connected areas as you set out to find a member of your settlement, The Ark, who's gone missing. You'll encounter enemy encampments, weapon chests, scrap caches and weapon parts, which act as currency to buy gear and upgrade weapons back at the Ark, to which you can fast travel.

This setup gives the world a coherence that's lacking in most turn-based strategies, but it also means that between fights you must ponderously run through undergrowth in search of the scrap you'll need to afford vital medkits and grenades. The environmental detail often repays the time spent exploring, but I wish movement was faster so I could get to the tactics meat of the game more quickly.

Mutant Year Zero's key addition to the XCOM format is stealth. And it makes a huge difference. Combat starts either when you purposefully initiate it or if you blunder into an enemy's awareness radius,



which you can make smaller by crouching. This presents an opportunity to twist the encounter to your advantage by scouting the area to find vantage points, and it gives a fantastic sense of involvement in the ensuing fight, because so much results from the situation you set yourself.

Unfortunately, Mutant Year Zero too often leans on adding HP to enemies to raise the stakes. There are a good number of different types, from Molotov-throwing pyros to telekinetic leaders, medbots, and armoured tanks. Each demands different strategies, but by the mid-game most are introduced and I found the

majority of the challenge came in figuring out how to eke more damage out of my weapons via fussy fiddling with add-ons.

I found the story fulfilling enough. But in the 15 hours it took me to complete on Normal, I'd only just bought a couple of late-game skills and had barely used the other two characters; I wanted a chance to explore them. **■ Alex Wiltshire**

Verdict

The mix of tense tactics and real-time exploration gets much right.



11:45 A Vivid Life

Let's do some surgery.

FREE | PC
DECONSTRUCTTEAM.ITCH.
10/1145-A-VIVID-LIFE

A teenage girl steals an x-ray machine in order to perform gruesome experiments on her body. It's a hell of a premise!

Protagonist Laynie essentially decides her own story in this point-and-click. She feels that her skeleton isn't her own, and the obvious solution is to x-ray parts of her body, and then to cut out any foreign matter she finds.

The animation is too bloodless for anyone to be that grossed-out by the mutilation, but it's alarming how readily Laynie will harm herself. Presented with each bodily artefact, you then decide on their origin, be it supernatural or the result of abuse. Your answers subtly divert the story towards one extreme or the other.

I feel it's a narrative that only means something if the truth is grounded in real-world trauma, rather than in alien experimentation, but as none of the backstories is ever explicitly confirmed it's possible that any, or all, or none of the story options are really true.

I'm intrigued to see where the experiment will go from here, as this is a sturdy skeleton to build upon. **■ Tom Sykes**





The Doll Shop

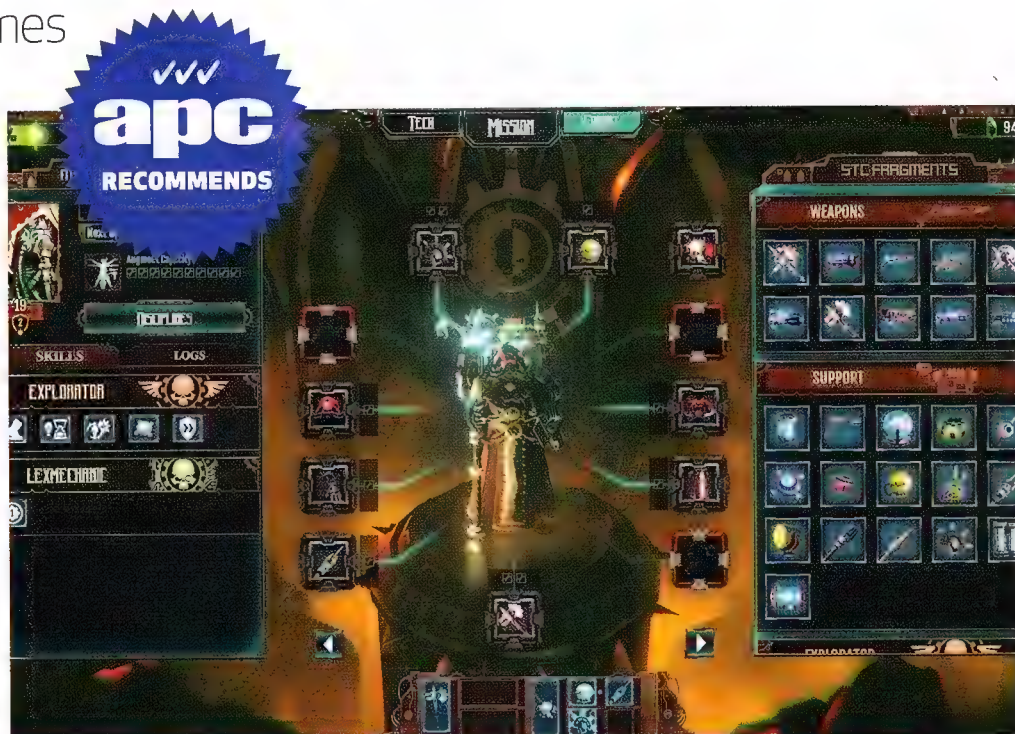
Painting dolls and eating ramen in a creepy adventure.

FREE | PC, MAC, LINUX
ATELIERSENTO.COM/
DOLLSHOP

Atelier Sento's *The Doll Shop* works so well as it takes the dating sim genre and carves out its beating heart. In this beautifully illustrated point-and-click, you play as a doll-maker in a remote Japanese village that has been tainted by tragedy.

Between dialogue blocks you're permitted to trudge around town at your leisure, taking in the melancholy atmosphere. This is a game about repetition, about the comforting familiarity of daily rituals, from your regular snowy meanderings to the delicate craft of your doll-making work. Occasionally you'll need to repair a broken doll, or attend to your butterfly collection. If it sounds dull, it strangely isn't: you're given a satisfying amount of visual and aural feedback as you use glue to seal a cracked face, or your paintbrush to erase all trace that it was ever damaged.

While on the surface the story of a blossoming romance, the darker elements bubble to the surface. Atelier Sento's game is expertly paced, taking the time to establish a baseline of normality, before it's overturned at the very end. ■ Tom Sykes



\$42.95 | PC | WWW.MECHANICUS40K.COM

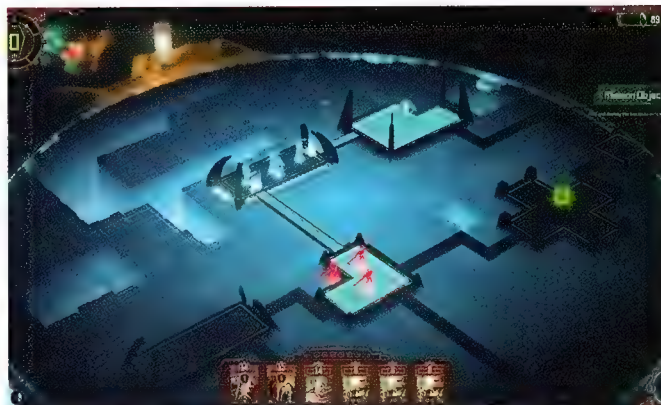
Warhammer 40K: Mechanicus

Succeeds by embracing the weird.

A few years ago, Games Workshop loosened its grip on the Warhammer 40,000 setting, and the result has been a glut of small-budget games set in the grim darkness of the far future. The quality has been mixed, but every so often a game like *Mechanicus* comes along that uses the opportunity to explore a previously neglected corner of the Warhammer universe, and makes it all worthwhile.

The Adeptus Mechanicus are, in many ways, the perfect encapsulation of what Warhammer 40,000 is about, a bizarre Gothic fusion of tech and religion. They are the chief scientists of the Empire, but treat science like a religious cult. *Mechanicus* translates this unusual faction into a tactics game.

The story is framed by a group of high-ranking tech priests who are constantly debating each mission. They're all wonderfully quirky characters: Scaevola has removed so much of their humanity they now speak in equations, the devout Videx believes ignorance is strength,



meanwhile their leader, Faustinius, has quarantined their emotions. They're *Mechanicus*' great strength, and I came to truly treasure their bickering.

In battle there's no such thing as cover, which makes combat fast and lethal, initially for the tech priests and then later, after a few upgrades, for the Necrons. Combat revolves around a currency called cognition, which can be earned by scanning obelisks and corpses, as well as lots of other methods, and can be spent on things like extra movement or more powerful actions.

The tech priests themselves are incredibly customisable. Each one can

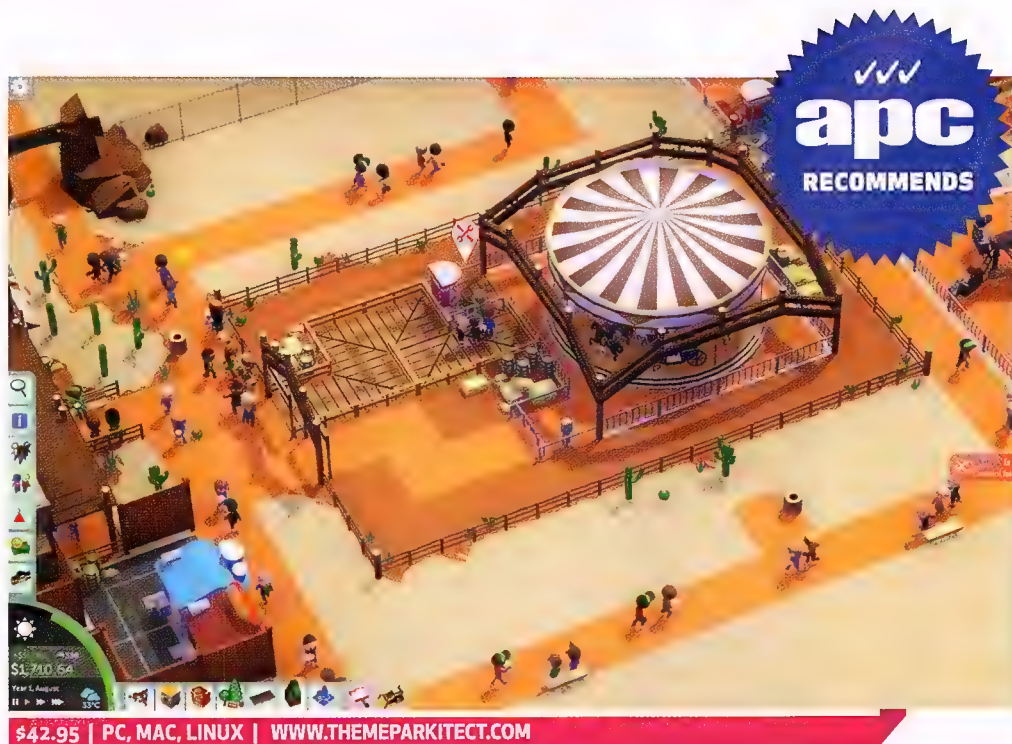
attach various strange gizmos, and has six skill trees to mix and match. By the time the Necron awakening timer had hit as little as 30% my tech priests had levelled up so much they were killing Necrons in one hit. I was still having fun while winning, I'd just substituted challenge for efficiency, as any true tech priest would. That is what keeps me coming back ■

Tom Hatfield

Verdict

A diet XCOM-style strategy game with some great characters.





\$42.95 | PC, MAC, LINUX | WWW.THEPARKITECT.COM

Parkitect

A worthy successor to Rollercoaster Tycoon.

Parkitect negotiates a pleasing balance between building and maintaining your theme park. Beyond the constraints of budget and available rides, you are free to create your park however you like. You can fill your park with standard rides and user-created coasters, or get hands-on with every detail, sculpting terrain, tweaking the turns and loops of every coaster, and constructing your own facades and decorations out of geometric shapes.

Creatively, *Parkitect* is sufficiently robust, although less powerful than the toolset of *Planet Coaster*. Paths can only be built in

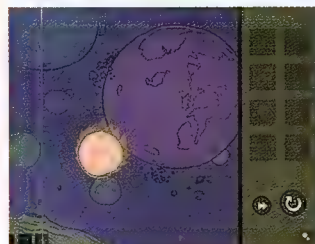
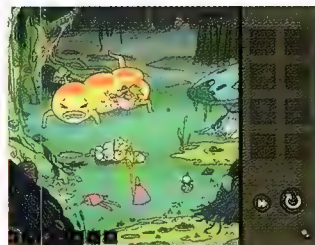
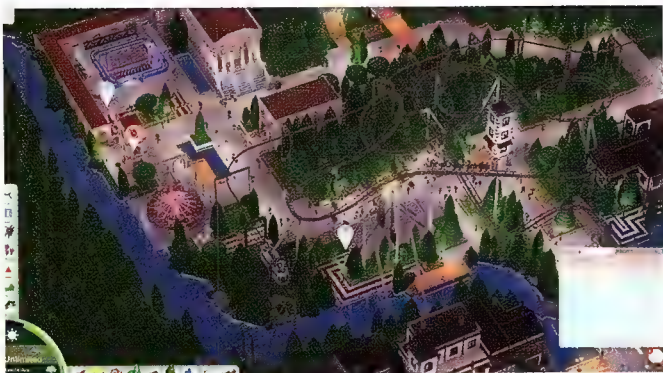
straight lines, while terrain cannot be manipulated with much fidelity. Where *Parkitect* has the edge on its rivals, however, is in how it challenges you to think harder about the layout and upkeep of your park.

Parkitect isn't short of stuff to do. Alongside the sandbox mode, the campaign includes 26 different parks to build, each of which has its own unique set of challenges. There are also dozens of rides to unlock, and the coaster selection is particularly impressive, ranging from simple junior coasters to log flumes, flying coasters, and even a bobsled run.

You can't fault *Parkitect* for its generosity, or for its

cleanly designed simulation. Nonetheless, it does exhibit a few issues. Most prominent is the UI, which is poorly designed. There's no undo button, so any mistakenly placed objects have to be manually demolished.

Parkitect is the most well-rounded theme-park simulator of recent years. But if you look at the management sim genre more broadly, there's stiff competition. From the quirky and characterful *Two Point Hospital*, to *Megaquarium*, which has a similar structure to *Parkitect*, but applies it to a very different setting. *Parkitect*, for all of its quality, is content to be a fairground attraction, fun and mechanically sound, but not something that you're going to want to queue up hours for. **■ Rick Lane**



Monstrüous

Can you restore order?

FREE | PC, MAC, LINUX
NONOMIYO.ITCH.IO/
MONSTRUOUS

Monstrüous is a wonderfully fluid point-and-click puzzler that posits the above question, while revelling in the outcomes of your decisions. Rather than controlling the four-person party directly, your sole interaction is deciding the order in which they perform their special moves. Will you have your amphibian bard dude summon a protective bubble right at the start, or in a few turns in when the monster has a mean look on his face? Will you give the princess empowering coffee before you summon that fiery comet or after those monstrous eggs have been laid at her feet? It's a game of trial and error, then – but it's rare that the error part is this much fun. This is a beautiful game, with a whimsical art style that reminds me of *Adventure Time*, and several hundred frames (surely) of slick animation. Every failed and successful attack, and every unforeseen death, triggers a charming bit of animation – really, seeing them all will be your main impetus for replaying the game. **■ Tom Sykes**

Verdict

A familiar ride that has been bettered elsewhere.



Diablo III is one of the few games that can give Disgaea a run for its money when it comes to absurdly huge damage numbers.

DEVELOPER: BLIZZARD PUBLISHER: BLIZZARD RELEASED: 2012 SYSTEM: PC, MAC, PS3, PS4, SWITCH, XBOX 360, XBOX ONE

Diablo III

Some games have 'classic' written all over them from the moment they are released, but others need time to earn that status. With the recent Switch release being perfect proof of how far *Diablo III* has come, it's time to confirm its legendary status

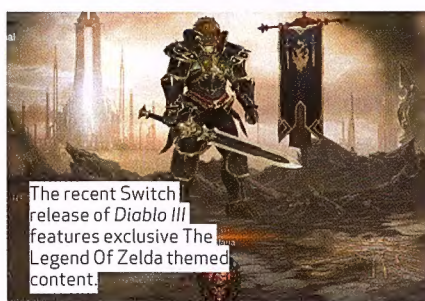
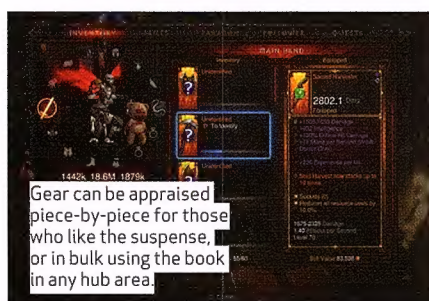
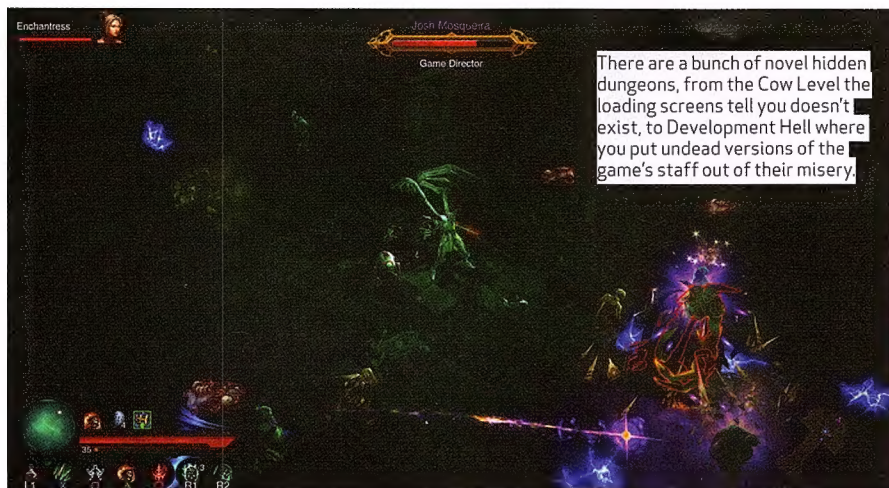
Following up one of the most revered action RPGs of all time was always going to be an uphill struggle for Blizzard. As with other high-profile returns of recent years like *Doom* and *Final Fantasy XV*, the game went through several iterations before the team reached something it was proud to call *Diablo*, leading to a whopping seven years of development before the game was first revealed in 2008, then a further four years of development before release. Some fans weren't overly enamoured with the art direction at first, with numerous petitions decrying the apparent shift to a more colourful palette almost reminiscent of Blizzard's other big hit, *World Of Warcraft*. Like so many similar outcries, this response was wildly exaggerated and Blizzard took it in its stride – in fact, the final game shipped with a secret level called Whimsydale in response, a cartoon world full of rainbows, unicorns and murderous teddy bears. While the game itself proved to be a solid and engaging lootfest, it wasn't until the 2014 *Reaper Of Souls* expansion that it really hit its stride, with the massive update adding several bottomless new modes that meant that the loot grind never had to end.

THE GAME

Reaper Of Souls can be seen as the turning point for *Diablo III* – the moment it went from being a good game to a truly great one. The core game had the loot system and skill variants to facilitate many awesome character builds, but it didn't really offer that much in the way of replayable content to put those creations to use. *Reaper Of Souls* introduced a pair of solutions to this issue, namely Adventure mode and Rifts. Adventure is basically a freeplay option, letting heroes dive into any of the maps from the campaign to complete bespoke challenges and bounties. Tile-based maps mean that layouts and enemy placement differ on each visit; some variants bring with them additional missions or other chances for extra loot, while completing whole sets of tasks in each act offers yet more rewards. On top of this, Rifts take things a step further by producing unique dungeons at random from all of the game's available locations and monsters. The basic versions, Nephalem Rifts, are tied to your current difficulty level (the options for which were also vastly expanded in *Reaper Of Souls*) and offer plenty of shiny loot as you battle your way to the Rift Guardian, but it's the super-challenging Greater Rifts that really provide endless action

Key facts

- Amazingly, Blizzard is still supporting the much-older *Diablo II* as well – the last patch came out in June 2016, 16 years after the game's initial release.
- *Diablo III* was over a decade in the making, with work starting on the project seven whole years before its 2008 announcement.



and improvement. These have their own difficulty levels independent of that chosen for the rest of the game, with success within the allotted time unlocking higher tiers and potentially even greater rewards. Greater Rift 'pushing' – the act of just seeing how far through the ranks you can get – is almost a game in itself, an endless loop of slight gear improvements and gem upgrades that you can easily lose months to if you go hard on it. Pushing beyond GR60 transcends the games maximum difficulty level, Torment XIII (which, for reference, itself ups base monster health by over 2 million per cent and enemy damage by a factor of almost 300), so only the best builds will even get to that point, let alone beyond it.

Fortunately, the game has other systems in play to help determined adventurers reach their full potential. The Paragon system is the best example of this: once you hit max level with a character, all further experience goes into an account-wide Paragon level pool with each level translating to a minuscule stat boost of your choice to help further improve your build. As these additional points rack up into the hundreds and even thousands, though, you start to see significant benefits and ones that apply to all your max level characters, making playing as one rewarding for all of them. Since each offers their own twist on the hack-and-slash action-RPG formula – Wizard and Demon Hunter play mean ranged games, Barbarian, Monk and Crusader excel in

close quarters, and Witch Doctor and Necromancer have pets and status ailments do the work for them – it's great fun to bounce between them, especially in multiplayer where these roles synergise brilliantly. It's pretty amazing that the game's performance keeps up with the mayhem with four characters, dozens of enemies, countless explosive effects going off, and loot and debris flying all over the place, but that's just part of the incredible sense of overall polish that makes *Diablo III* stand out from its peers. There are plenty of games like it, sure, but we'd struggled to name one that was nearly as slick as this.

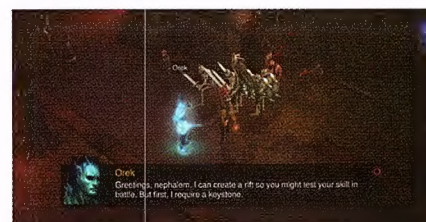
WHY IT'S A FUTURE CLASSIC

When we talk about games being 'classics', we're usually referring to the fact that it's as good to play today as it was at launch. *Diablo III* is an odd case, then, because it's already a lot better. While it's technically still possible to play the vanilla game, most versions playable on modern platforms are all-inclusive packages that contain all the new hotness that transformed *Diablo III* into a best-in-class loot grind action RPG. Whether you want to return to the game today or ten years down the line, it's one of these versions that we'd recommend – *Reaper Of Souls* made the experience genuinely bottomless with so many new ways to play and new things to strive towards; it's a game that has been in our rotation since launch and will be for years to come now we can play it on the go thanks to the Switch release.



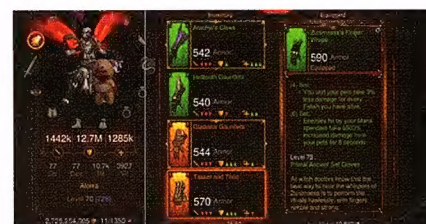
Seasoned To Perfection

Season mode invites players to create fresh characters every three months or so, and chase exclusive timed rewards.



Do You Even Rift?

Nephalem Rifts are randomised dungeons, while Greater Rifts escalate in difficulty. Both add incredible replay value.



Primal Rage

Loot chasers will be on the lookout for rare Ancient versions of Legendary gear that have better stats, and there are even ultra-rare Primal variants that have perfect stat rolls.



What's In The Box?

Kanai's Cube is a crucial part of endgame character building, letting players equip the unique perks of several Legendary items they have infused into it.



Shutting Up Shop

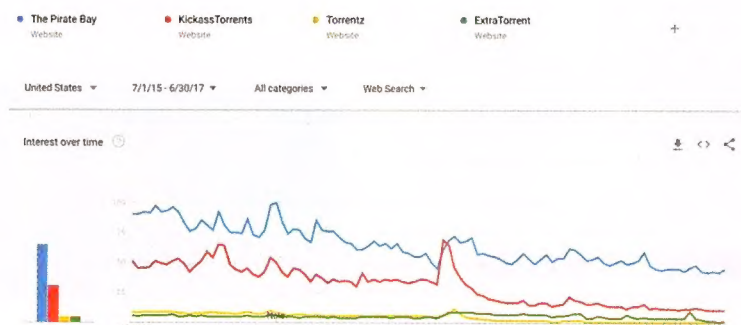
The PC version launched with Auction Houses where loot could be traded with other players for gold or real money. After backlash, both options were axed within two years. ■



Mark Zuckerberg says critics are too 'negative' about Facebook's missteps

You got to accentuate the positive, eliminate the negative.

Privacy breaches, election tampering, fake news and ethnic violence clearly aren't that big a deal to Facebook's commander in chief, Mark Zuckerberg. If we take his words literally, these things are at least less of a big deal, on balance, than adding Facebook Marketplace, retractable messages, and 157 new emojis to its services. In a Facebook post celebrating the company's 15th birthday the CEO stated, "As networks of people replace traditional hierarchies and reshape many institutions... there is a tendency of some people to lament this change, to overly emphasize the negative, and in some cases to go so far as saying the shift... is mostly harmful to society and democracy."

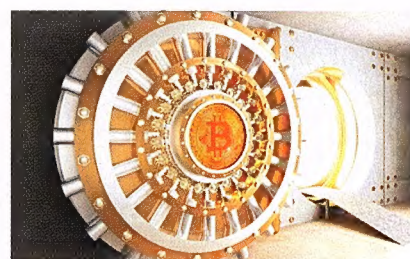


Source: Google Trends

Study finds pirated movies can increase box office revenues

MAYBE 2016 TORRENTERS SHOULD SUE THE DALLAS BUYERS CLUB OWNERS FOR PROMOTIONAL FEES.

In 2014 when the Pirate Bay's Swedish headquarters were raided and the site was dismantled, many thought this would be a big win for the movie industry, but a team of researchers decided to test the outcome scientifically. Using box office data from before and after the shutdown, researchers from the University of Houston and the University of Western Ontario found that while torrents available before a film's release date led to an 11% reduction in the total box office takings, torrents that surfaced on or after the film's release date actually provoked a 3% net positive effect on the film's total revenues. The researchers hypothesize this was due to a boost in word-of-mouth advertising.



US\$137 million cryptocurrency vault buried following CEO's death

QUADRIGACX'S DIGITAL ASSETS MAY NEVER BE RECOVERED.

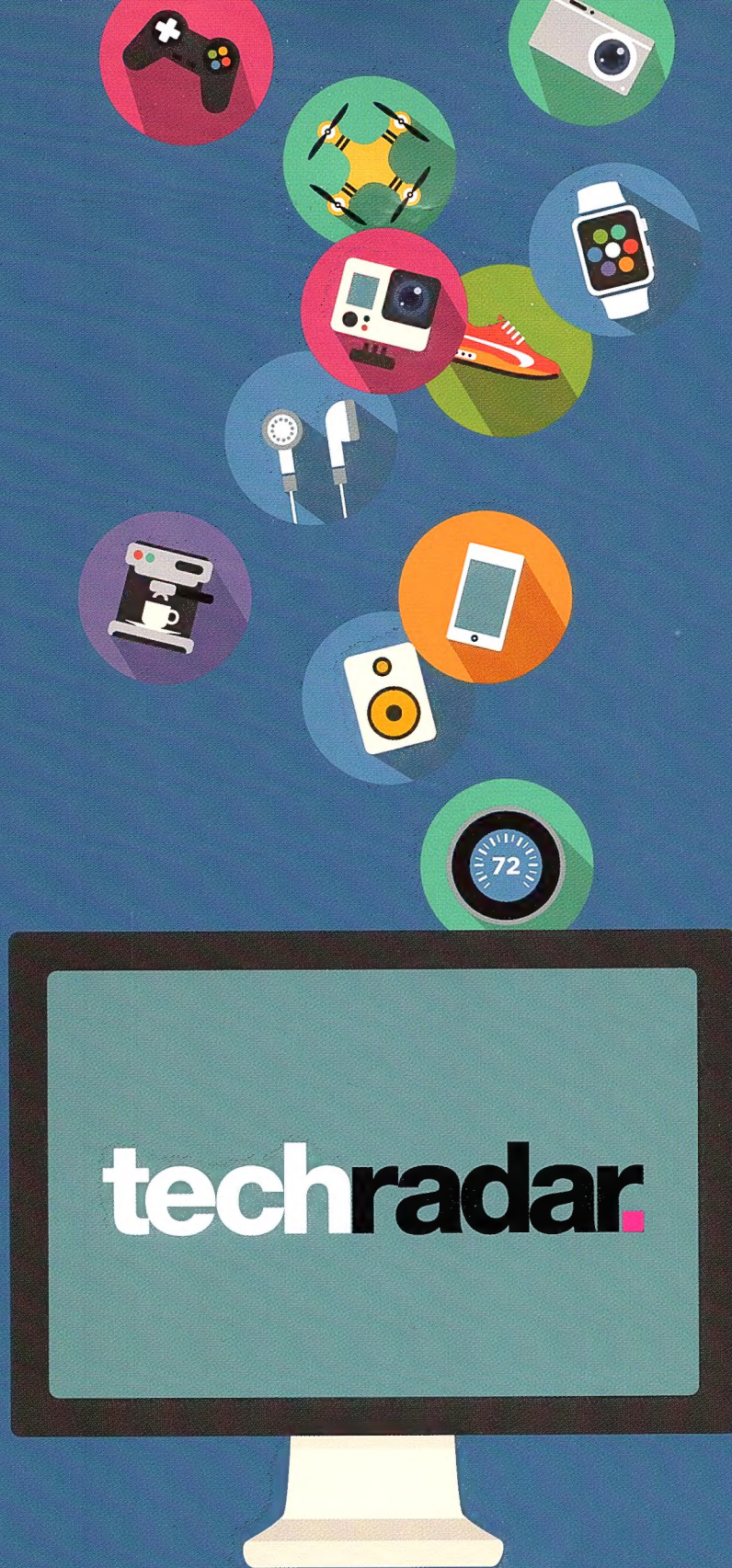
Gerry Cotten, the CEO of Canadian cryptocurrency exchange QuadrigaCX, died unexpectedly on a trip to India in December 2018, holding the only keys to the company's digital asset vault. In an unusual and finite security structure, Cotten was the only entity with access to US\$137 million of the exchange's 'cold' stored cryptocurrency. While QuadrigaCX has been granted a 30 day grace period before investors can sue the company, the widow of the deceased, Jennifer Robertson, stated that while she had her husband's laptop and USB – which likely to contain the keys to the digital vault – she does not have the credentials to log onto them.



Fortnite hosts the world's biggest live music festival

MARSHMELLO PIONEERS THE GENERATION Z 'KUM BA YAH'.

Growing up, marshmallows were a treat you melted with friends around a campfire, but for a generation of kids that haven't experienced an internetless world, Marshmello is something very different. 10 million people logged on to watch the youth-pop DJ play a virtual concert in the battle royal shooter, *Fortnite*. This many concurrent online users is an number that few games will ever achieve, but it's perhaps an even more dramatic moment for music, considering the festival was 200 times larger than the average headline-act concerts. The event was free to watch, however in-game Marshmello outfit merchandise was on sale for 1,500 V-bucks (about \$20). ■



The home of technology

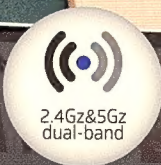
techradar.com

BiPAC 8700 Dual-band Series

Our telecommunication capability
can grow your business
in entirely new ways.



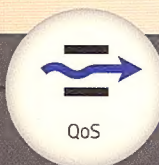
VDSL2/ADSL2+



2.4Gz&5Gz
dual-band



Auto
Failover /Fallback



QoS



Firewall

- ❖ Compliant with VDSL2/ADSL2+ Standard
- ❖ Triple WAN for 3G/4GLTE, VDSL2/ADSL2+, and EWAN for broadband connectivity
- ❖ Auto Failover and Fallback
- ❖ Simultaneous dual-band wireless 802.11ac 1300Mbps (5GHz) and 802.11n 300Mbps (2.4GHz) support

- ❖ 5 Giga Ethernet ports included, port #5 can be configured as Ethernet WAN
- ❖ QoS and firewall supported
- ❖ 2 FXS ports for SIP VoIP call (option)
- ❖ VPN tunnels for IPSec, OpenVPN, GRE, L2TP, and PPTP connections (option)